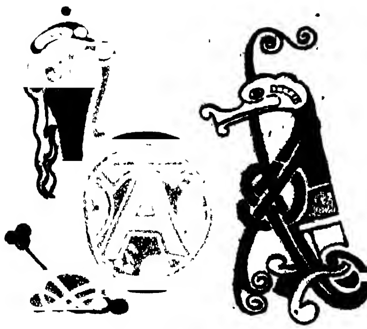
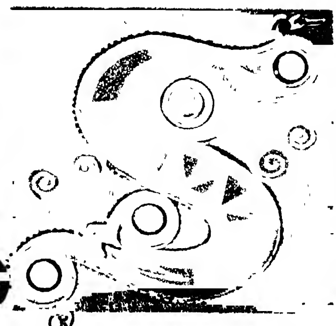
ILLUMINATING.

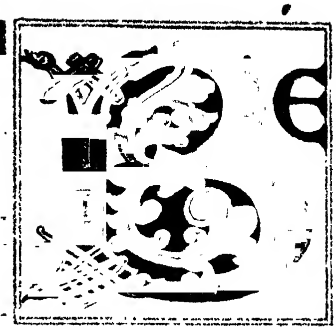
(CAPITALS CHRONOLOGICALLY ARRANGED)



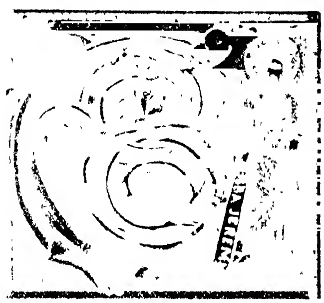
B A VIIth CENTURY



S VIIth or VIIIth CENTURY

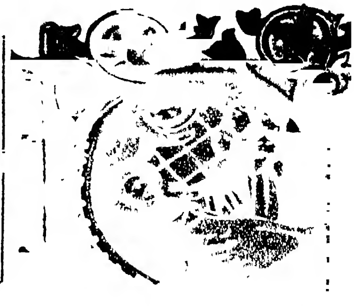


B Xth CENTURY

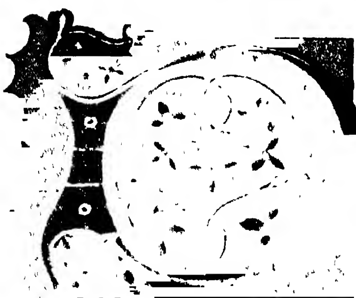


U XIIth CENTURY

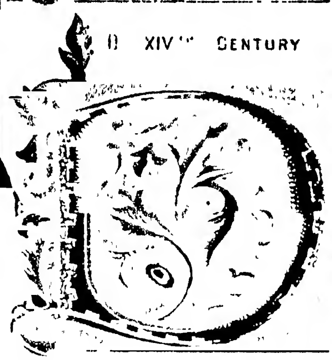
D XIVth CENTURY



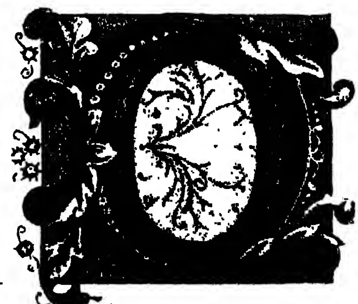
C XIVth CENTURY



D. EARLY XVth CENTURY



D LATE XVth CENTURY



V ITALIAN XVth CENTURY.

C GERMAN XVIth CENTURY

C ITALIAN XVIth CENTURY

O FRENCH XVIIth CENTURY

The National Encyclopaedia

A Dictionary of Universal Knowledge.

By

WRITERS OF EMINENCE IN

LITERATURE, SCIENCE, AND ART

VOLUME VII

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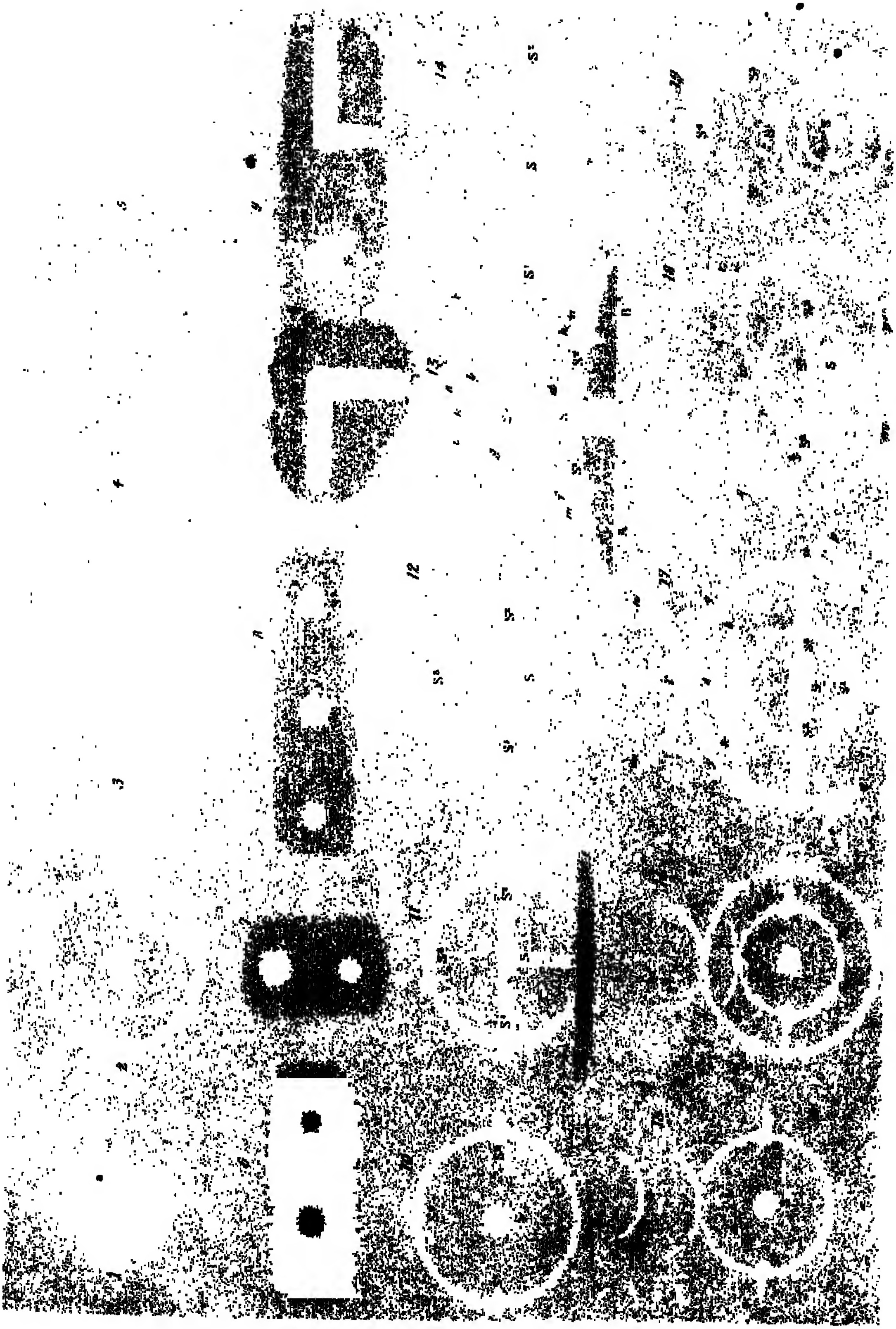


HEAT.

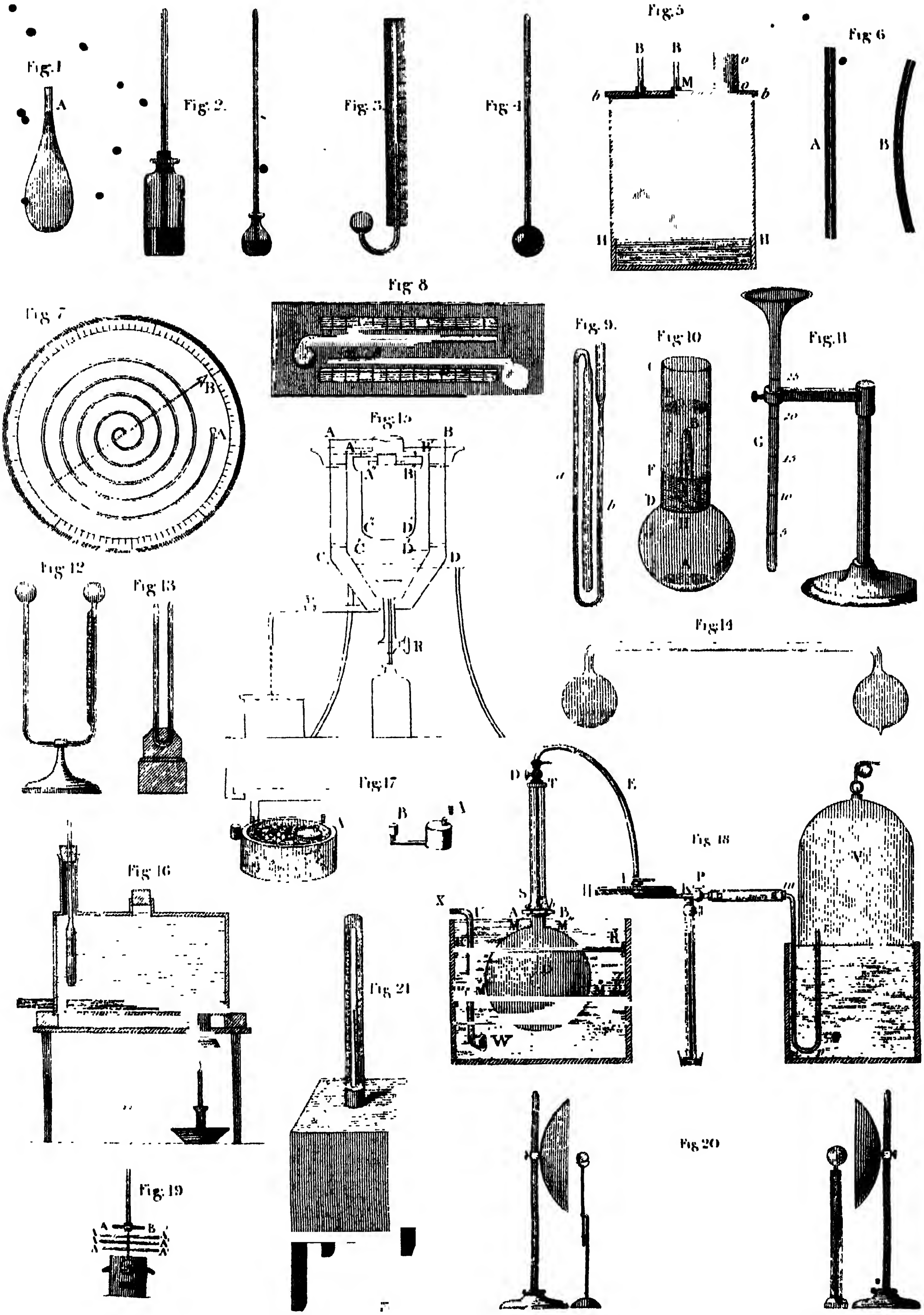
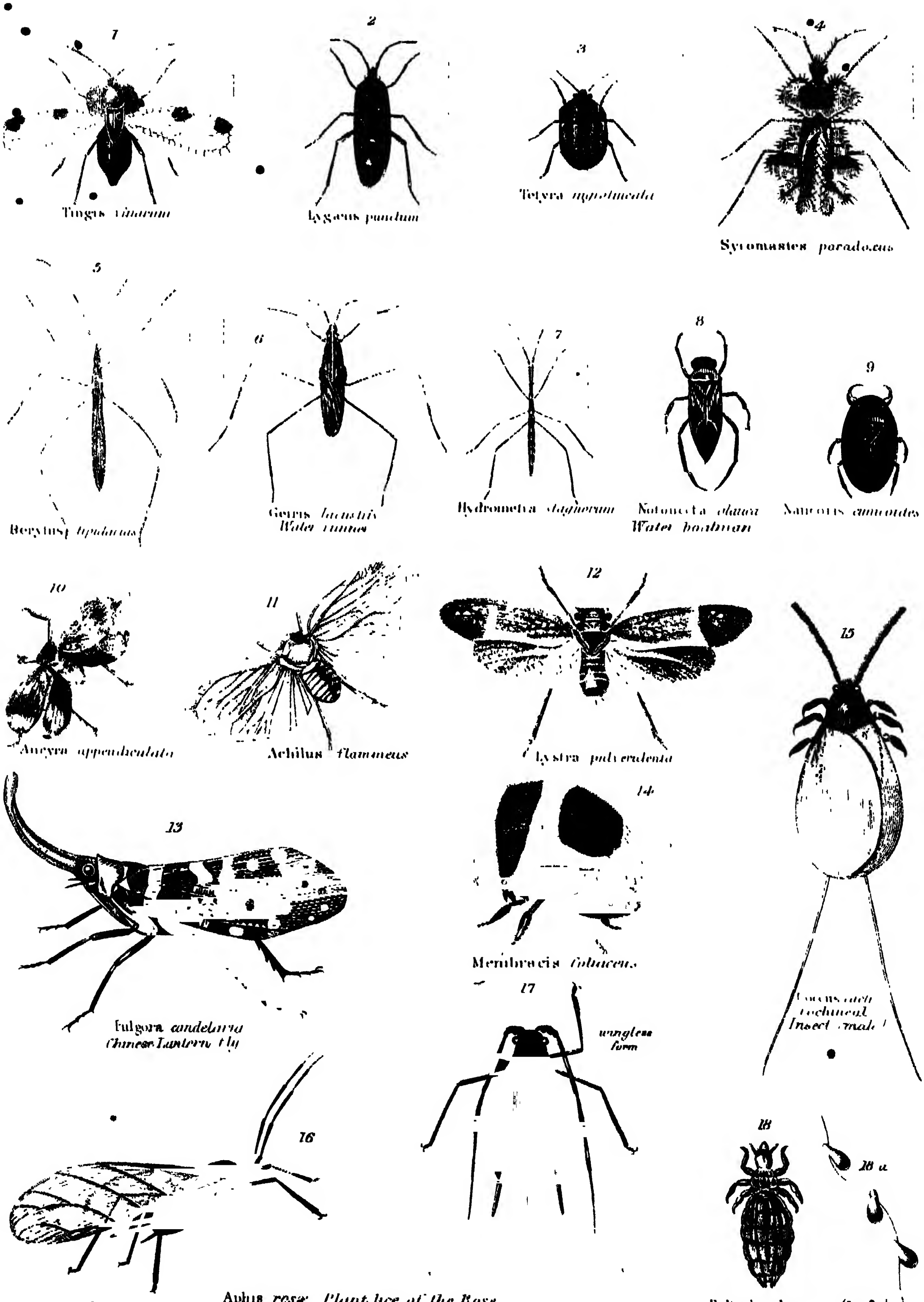


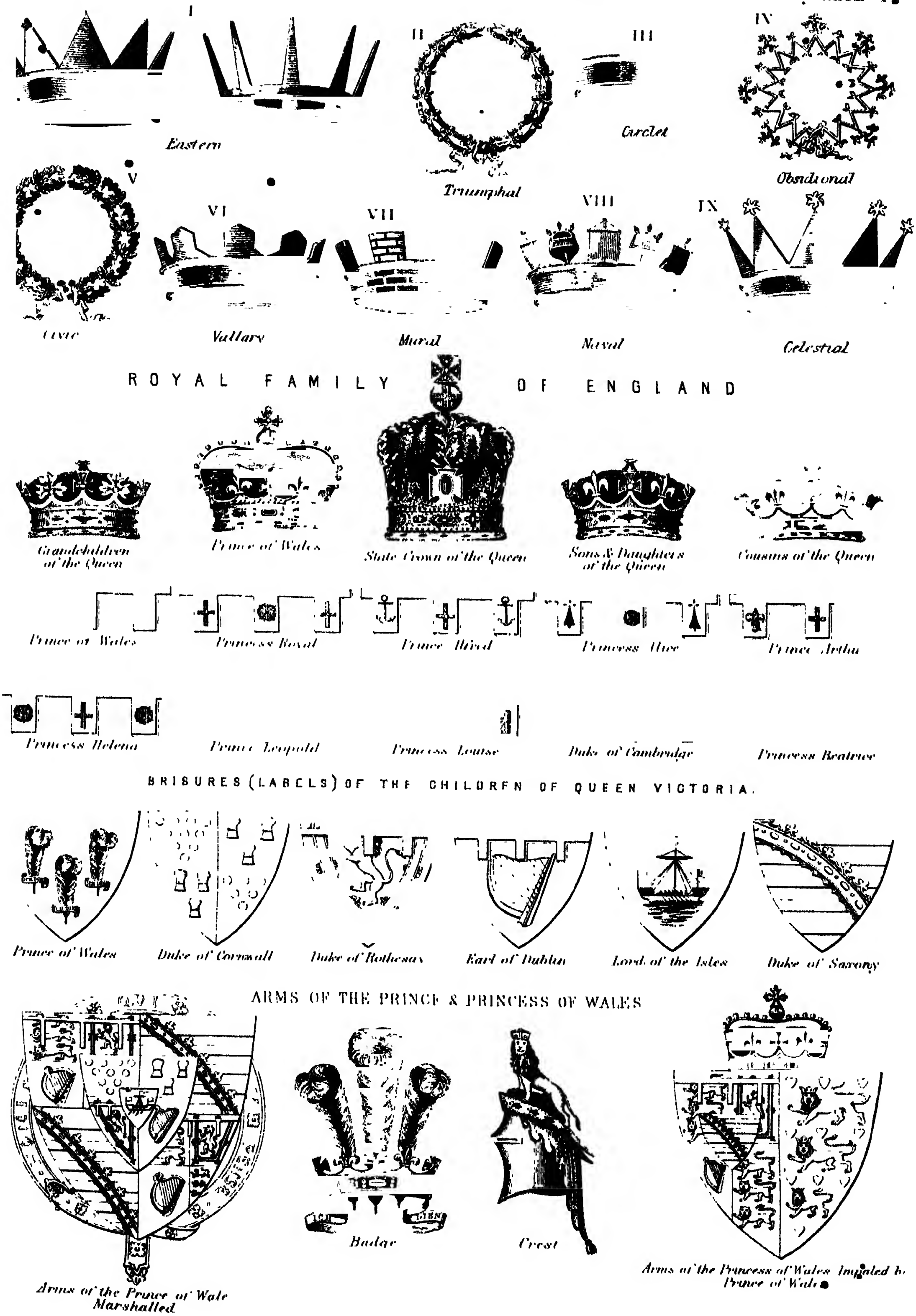
Fig. 1
Fig. 2.
Fig. 3.
Fig. 4
Fig. 5
Fig. 6
Fig. 7
Fig. 8
Fig. 9.
Fig. 10
Fig. 11
Fig. 12
Fig. 13
Fig. 14
Fig. 15
Fig. 16
Fig. 17
Fig. 18
Fig. 19
Fig. 20
Fig. 21

HEMIPTERA.


1
Tingis
2
Lygaeus punctum
3
Tetyra
4
Syromastes paradoxus
5
Berytus tipularius
6
Gerris lacustris
Water runner
7
Hydrometra stagnorum
8
Notonecta glauca
Water boatman
9
Naucoris cimicoides
10
Ancyra appendiculata
11
Achilus flammeus
12
Clystra pulverulenta
15
13
Fulgora candelaria
Chinese Lantern Fly
14
Membracis foliacea
17
wingless form
Coccus cacti
cochineal
Insect (male)
16
Aphis rosæ Plant lice of the Rose
18
18 a
Pediculus humanus (Louse)

HERALDRY.

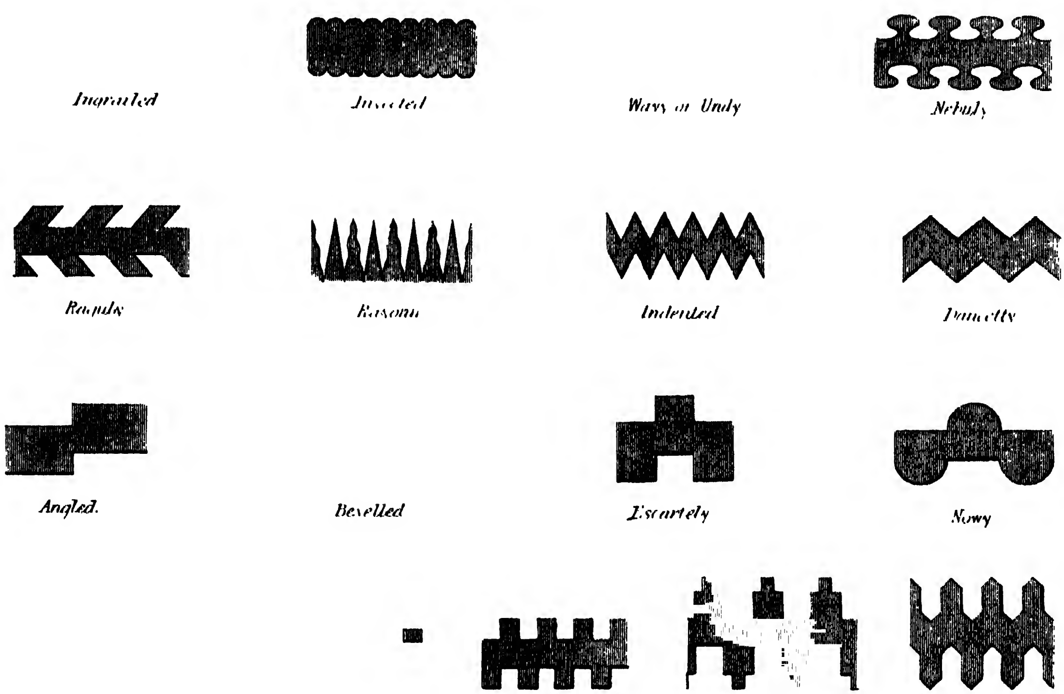
PLATE 1.



R A L D R Y.

Honour points. *Metals.* *Colours.* *Furs (1)* *Furs (2)*

VARIED BOUNDARIES, OR EDGES, OF THE ORDINARIES.



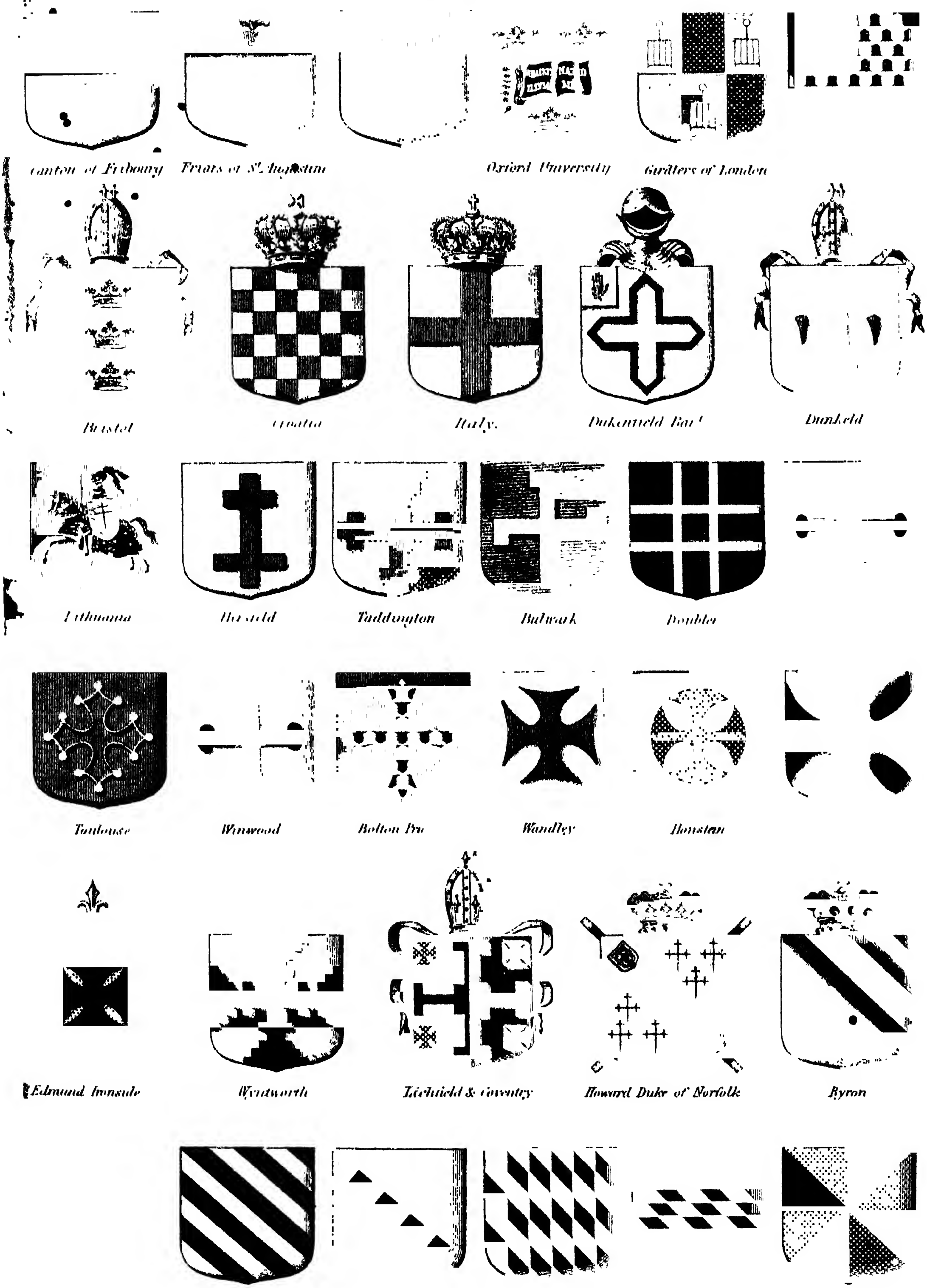
Ingrailed *Invected* *Wavy or Undy* *Nebuly*

Raguly *Rayonné* *Indented* *Dancetty*

Angled. *Bevelled* *Escartely* *Nowy*

Dovetail. *Potent* *Embattled or Crenelly* *Battled Embattled* *[illegible] or Urdy*

Beauvais (town) *Mechlin* *Bellasius quartered with Bella.* *Harcourt* *Hungary*



Canton of Fribourg

Friars of St. Augustine

Oxford University

Girdlers of London

Bristol

Croatia

Italy.

Dukenfield Bart.

Dunkeld

Lithuania

Hersfeld

Taddington

Bulwark

Doubler

Toulouse

Winwood

Bolton Pri.

Wandley

Honstan

Edmund Ironside

Wentworth

Lichfield & Coventry

Howard Duke of Norfolk

Byron

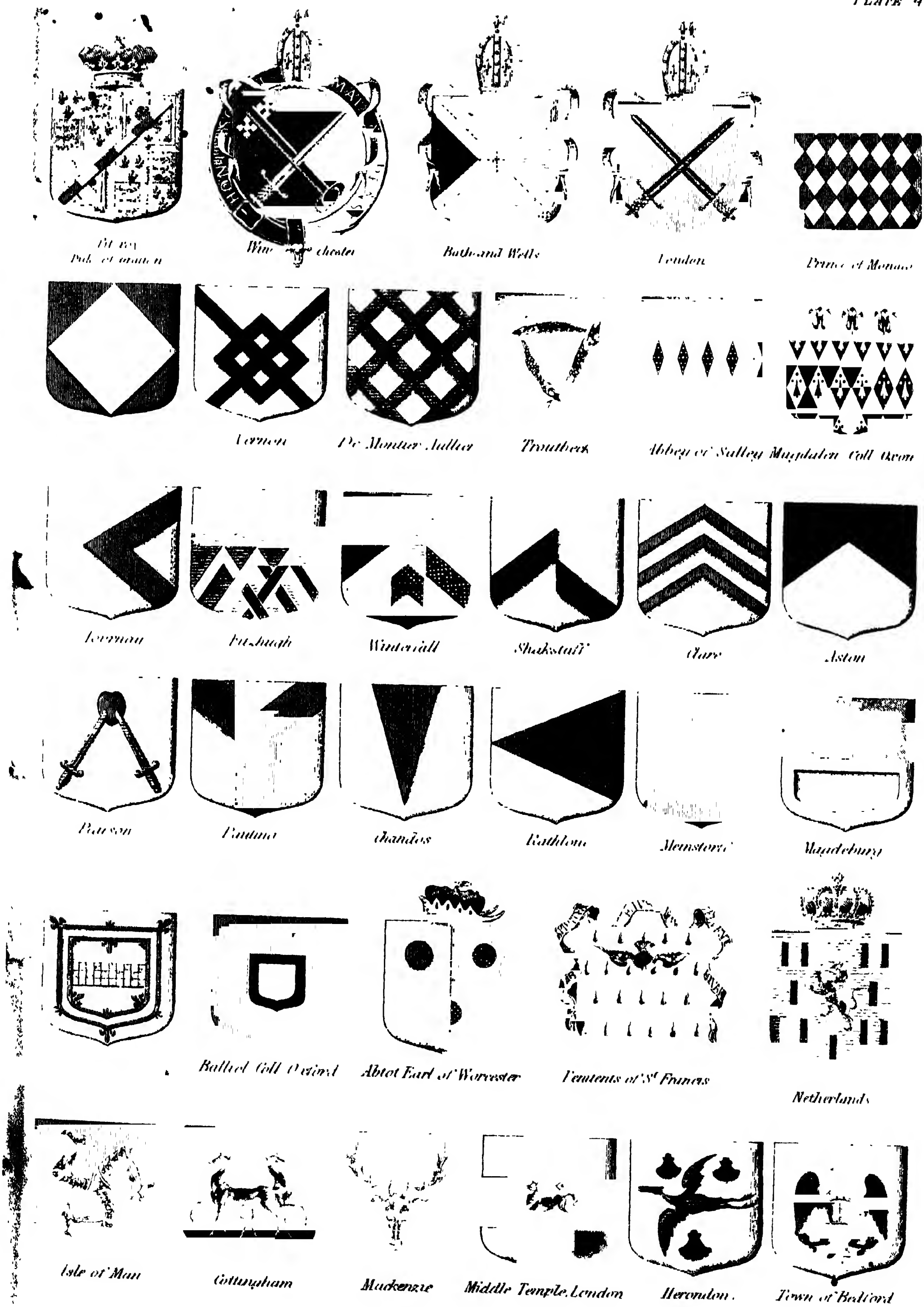
Angoulême

Beyle

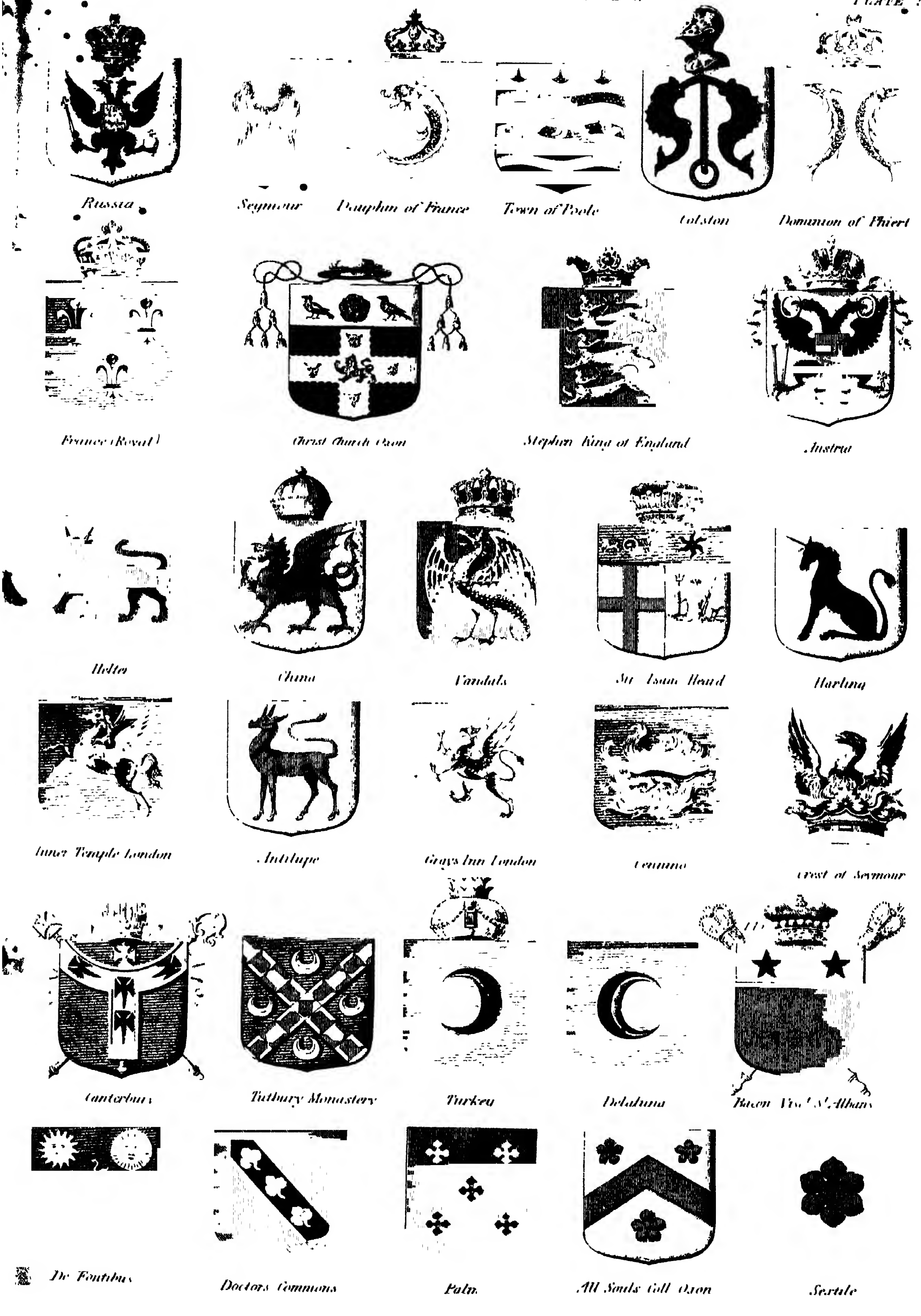
Bavaria

Rusberg

Campbell


Bath and Wells
London
Troutbeck
Abbey of Salley
Magdalen Coll Oxon
Fitzhugh
Winterall
Shakstaff
Clare
Aston
Chandos
Magdeburg
Balliol Coll Oxford
Abtot Earl of Worcester
Penitents of St Francis
Netherlands
Isle of Man
Cottingham
Mackenzie
Middle Temple London
Herondon.
Town of Bedford

HERALDRY.


Russia
Seymour
Dauphin of France
Town of Poole
Colston
Dominion of Thiert
France (Royal)
Christ Church Oxon
Stephen King of England
Austria
Helter
China
Vandals
Sir Isaac Heard
Harling
Inner Temple London
Antelope
Grays Inn London
Cemino
Crest of Seymour
Canterbury
Tutbury Monastery
Turkey
Delaluna
Bacon Visc^t St Albans
De Fontibus
Doctors Commons
Palm
All Souls Coll Oxon
Sextile

HIEROGLYPHICS.

PLATE I.

FIGURES OF GODS

Amen-Ra, or Amun Ra (Ammon).

Knum (Chnuphis).

Ra, or Phrah, or Phré (the Sun).

Ptah or Phthah (Hephæstos).

Ptah or Phthah Sokari.

Shu (Hêraklês).

Tefnet.

Natphé (Rhéa).

Osiris.

Isis.

Horus

Horus, as son of Isis.

Anubis.

Smé.

Thoth (Hermês.)

Atmû.

Bennu (phœnix).

Sebak.

Neith (Athêna).

Khuns.

Nephthys.

GROUPS, IDEOGRAPHIC AND PHONETIC

Eye and throne, i.e. "Osirian king," title of deceased sovereigns.

Bee—title of king of industrious and obedient peoples.

Key, signifying life, particularly divine life.

Weight or counterpoise.

Public assembly.

Altar. Religious worship.

Incense spoon for offerings.

Flowers.

Libation of purification or consecration.

Sacrifice (thigh of a victim).

Worship (suppliant at an altar with burning incense)

Votive offering Petition of subjects.

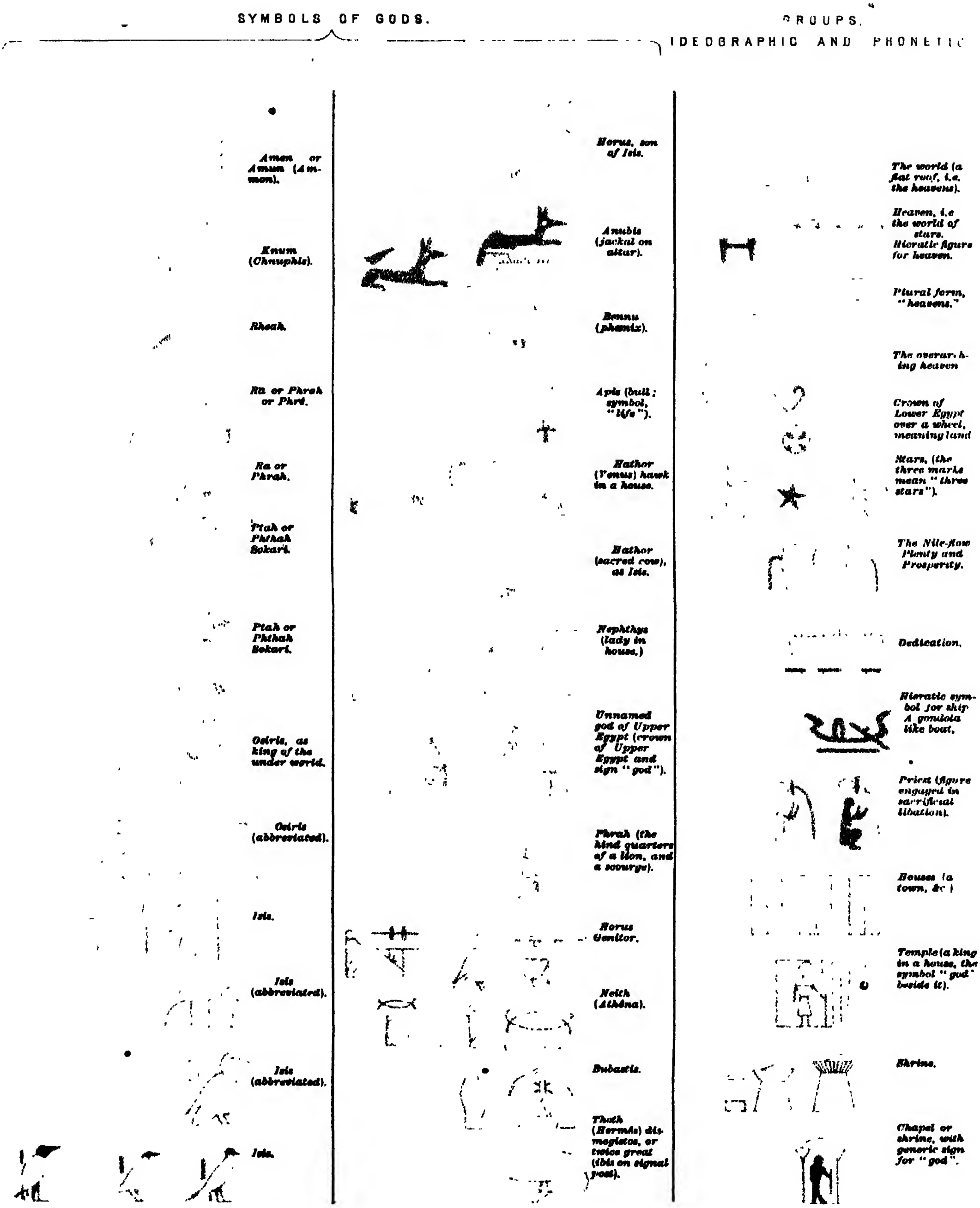
Libation or drink-offering.

Incense or fire-offering.

Writing, letter, &c. (A palette or tablet, inkstand, and reed).

Death (a gravestone)

HIEROGLYPHICS.

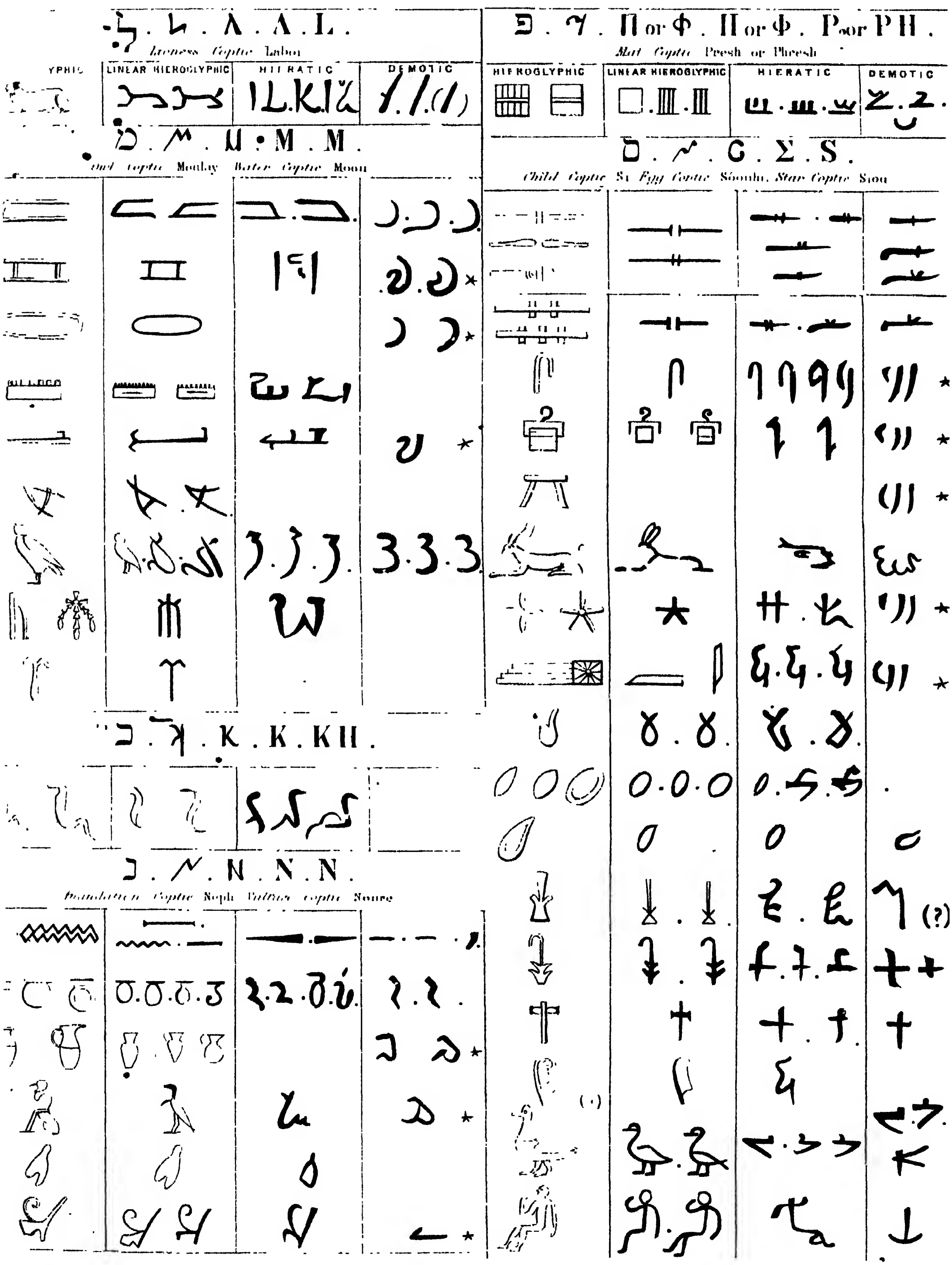


HIEROGLYPHICS.

PLATE 3.

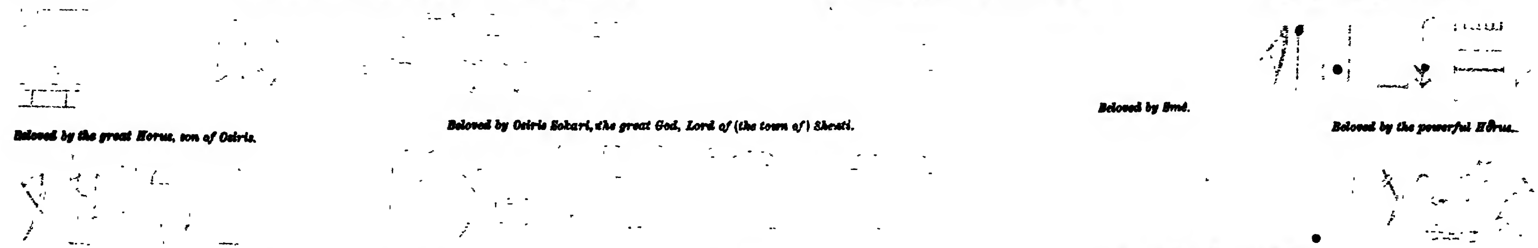
(SELECTED LETTERS OF THE ALPHABETS)

(HEADINGS IN HEBREW, PHŒNICIAN, COPTIC, GREEK AND ROMAN CHARACTERS)



Beloved by Hathor. *Beloved by Amen-Ra, God, Lord of the three Zones, Supreme Lord.* *Beloved by Amen-Ra, Lord of the three Zones.* *Beloved by Amen-Ra, King of Gods.*

Beloved by the great Horus, son of Osiris. *Beloved by Osiris Sokari, the great God, Lord of (the town of) Shesti.* *Beloved by Smé.* *Beloved by the powerful Hŏrus.*



PROPER NAMES OF KINGS.

All are inclosed in ovals called cartouches, and surmounted by the symbols over A and B, meaning "sovereign of an obedient people." The symbol need not therefore be repeated over each.

A. *Amenhotep or Amenophis I., 18th dynasty, called Memnón by the Greeks (Sun, lord of truth and justice).*

B. *Ramses I., founder of 19th dynasty, called Sesostris by the Greeks (Sun, guardian of truth, approved by Phrah).*

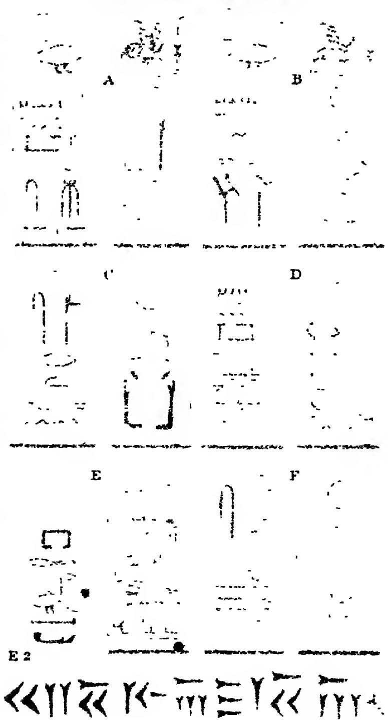
C. *Sheshonk I., founder of 22nd dynasty, the Shishak of the Bible (Sun of the superior region and of the world, approved by Phrah).*

D. *Osarthos, 23rd dynasty (Sun adored by the world).*

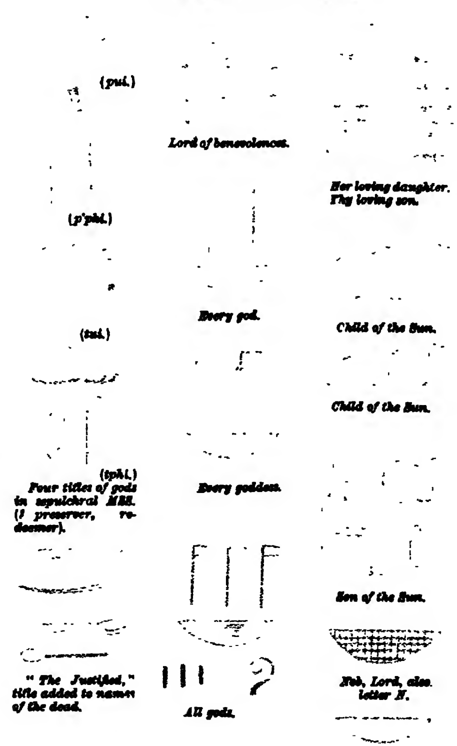
E. *Xerxes (Khshearsha), repeated in cuneiform characters beneath.*

F. *Psametik I., or Psammetichus, 26th dynasty, who threw open Egypt to the Greeks (Sun calm and beneficent).*

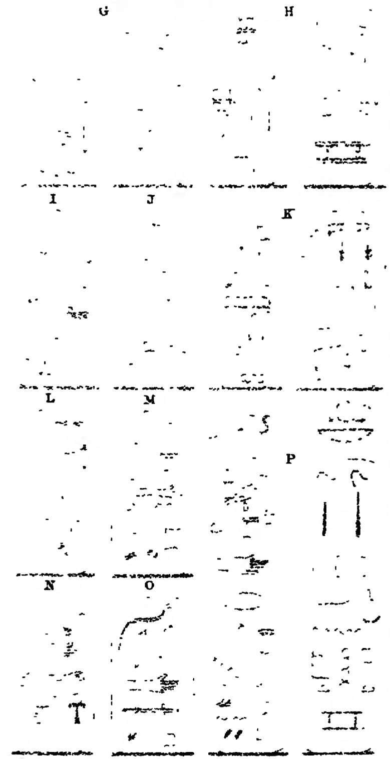
PROPER NAMES OF KINGS.



TITLES ATTACHED TO NAMES.



PROPER NAMES OF KINGS.



PROPER NAMES OF KINGS.

G. *Alexander the Great (beloved by Amen-Ra, approved by Phrah), Aleksantros.*

H. *Philip Aridaeus, brother of Alexander (beloved by Amun, cherished by Ra).*

I. *Cleopatra (Greek, Kleopatra).*

J. *Berenice, queen of Ptolemy Sôtêr.*

K. *Ptolemy Sôtêr I. (the gods saviours approved by Amen and Isis, possessing divine life).*

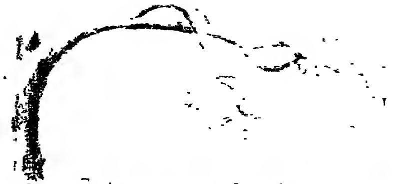
L. *Sabina (Roman Empress).*

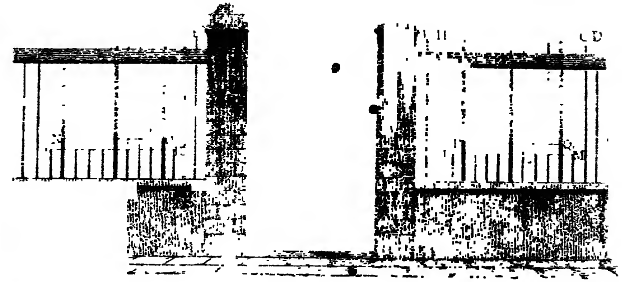
M. *The Emperor Vespasian (God on earth). From the Pamphilian obelisk at Rome.*

N. *Sebastê, i.e. Goddess (Empress).*

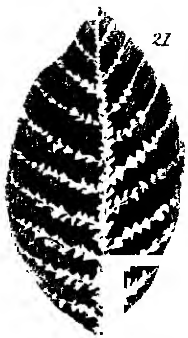
O. *The Emperor Titus (God on earth). Pamphilian obelisk.*

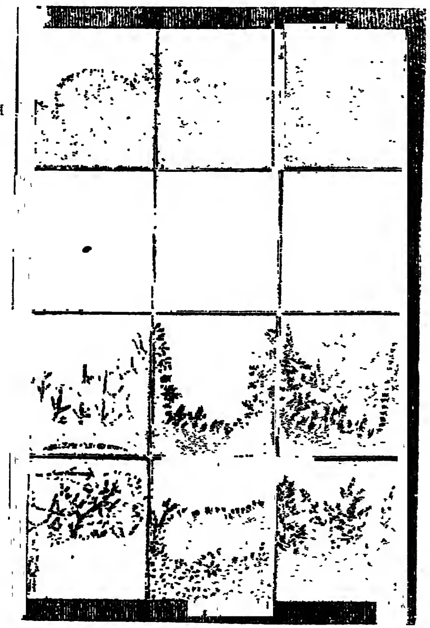
P. *The Emperor Nero—from Denderah (sovereign of the world approved by the gods benefactors Ptah and Osiris, son of Phrah, Autocrator, i.e. Emperor).*





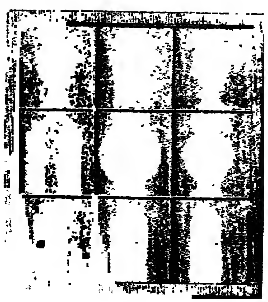
21





15 Sheets of Hoar Frost on a window

21



ross Section
quare iron
Spicules of Hoa
at each

22 Spicular hoar frost on a rough log.

26

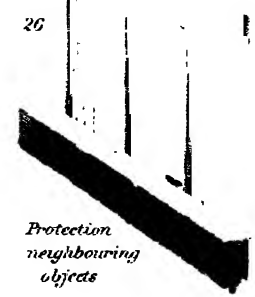
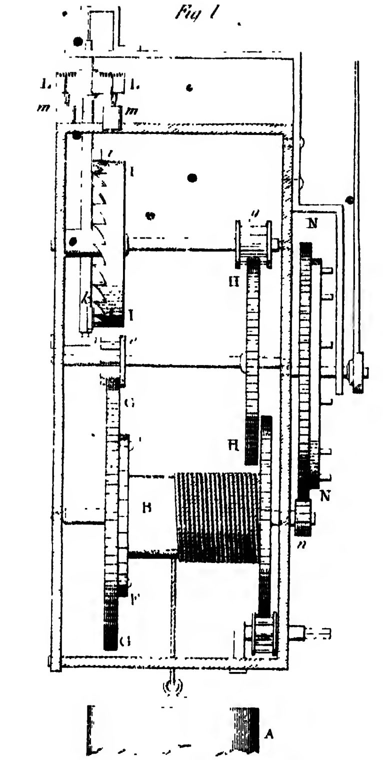
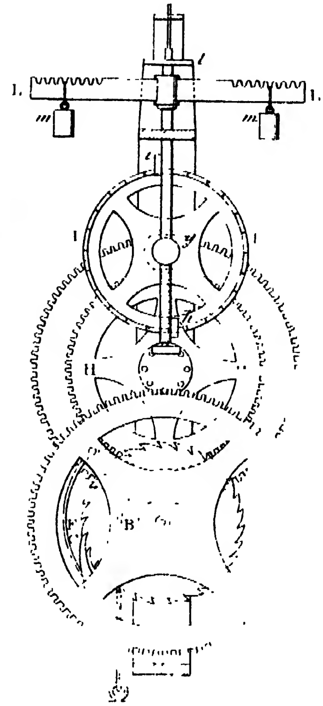


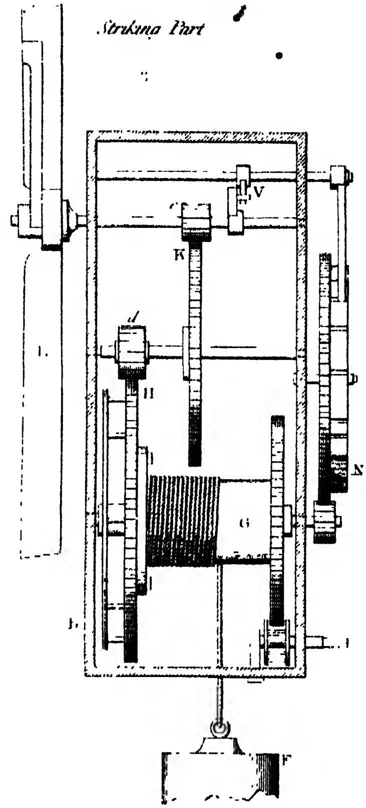
Fig 1



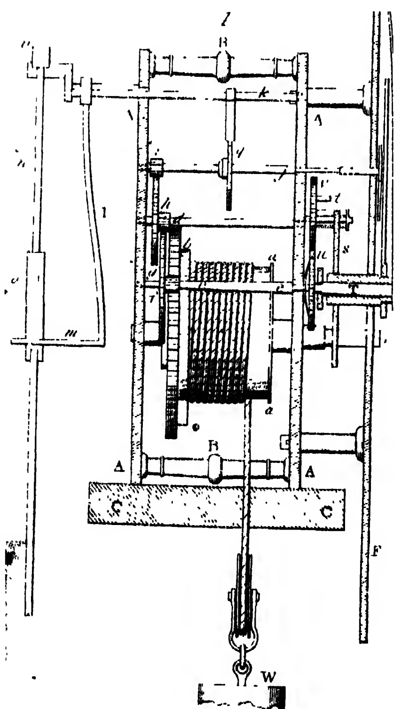
Ancient Clock by De Wyck



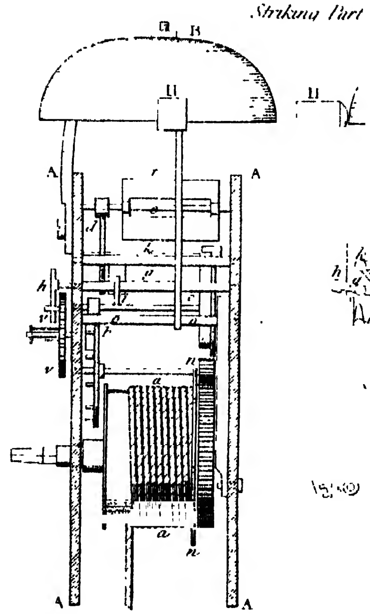
Striking Part

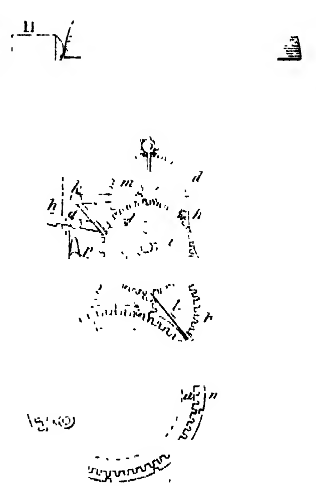


Modern Clock

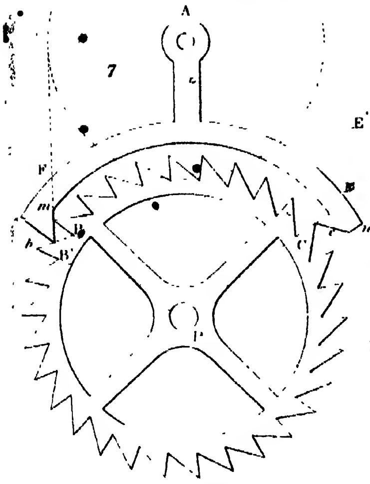


Striking Part



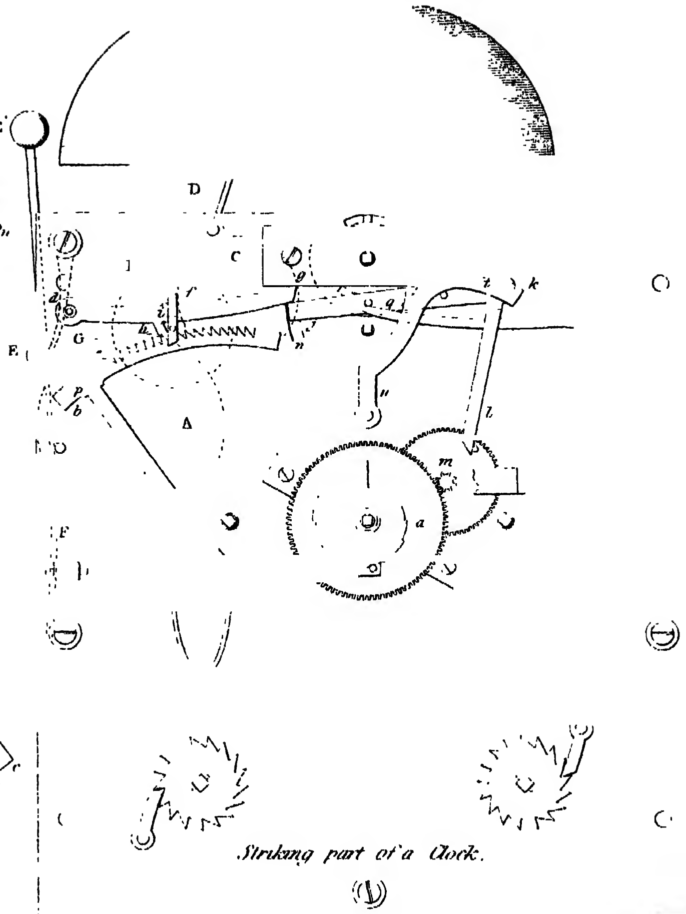


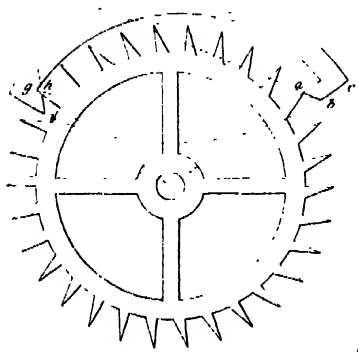
Anchor Escapement

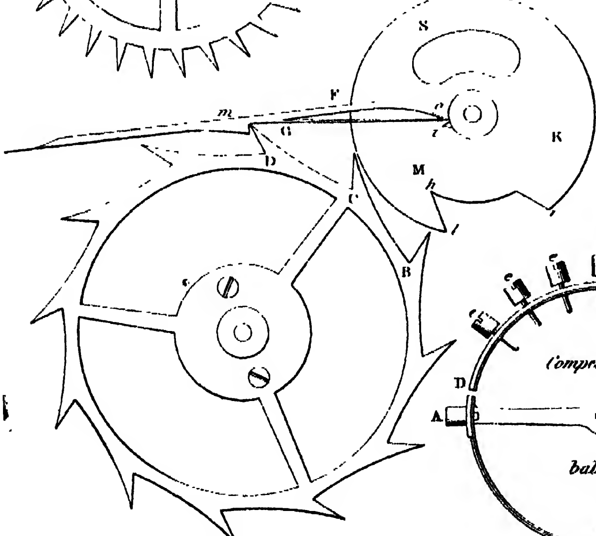


Graham's Dead beat

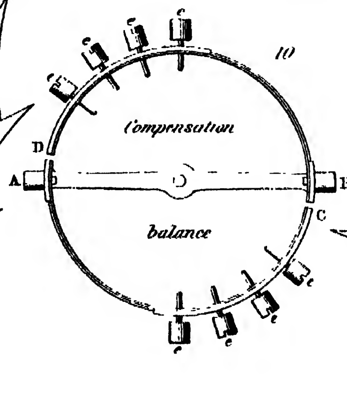
(C)

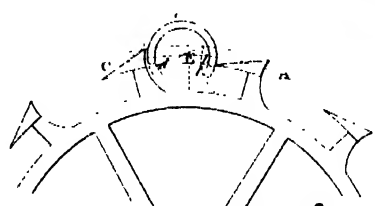




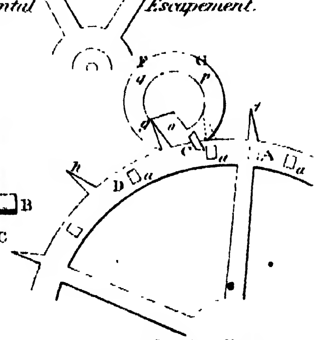


13 Chronometer Escapement.

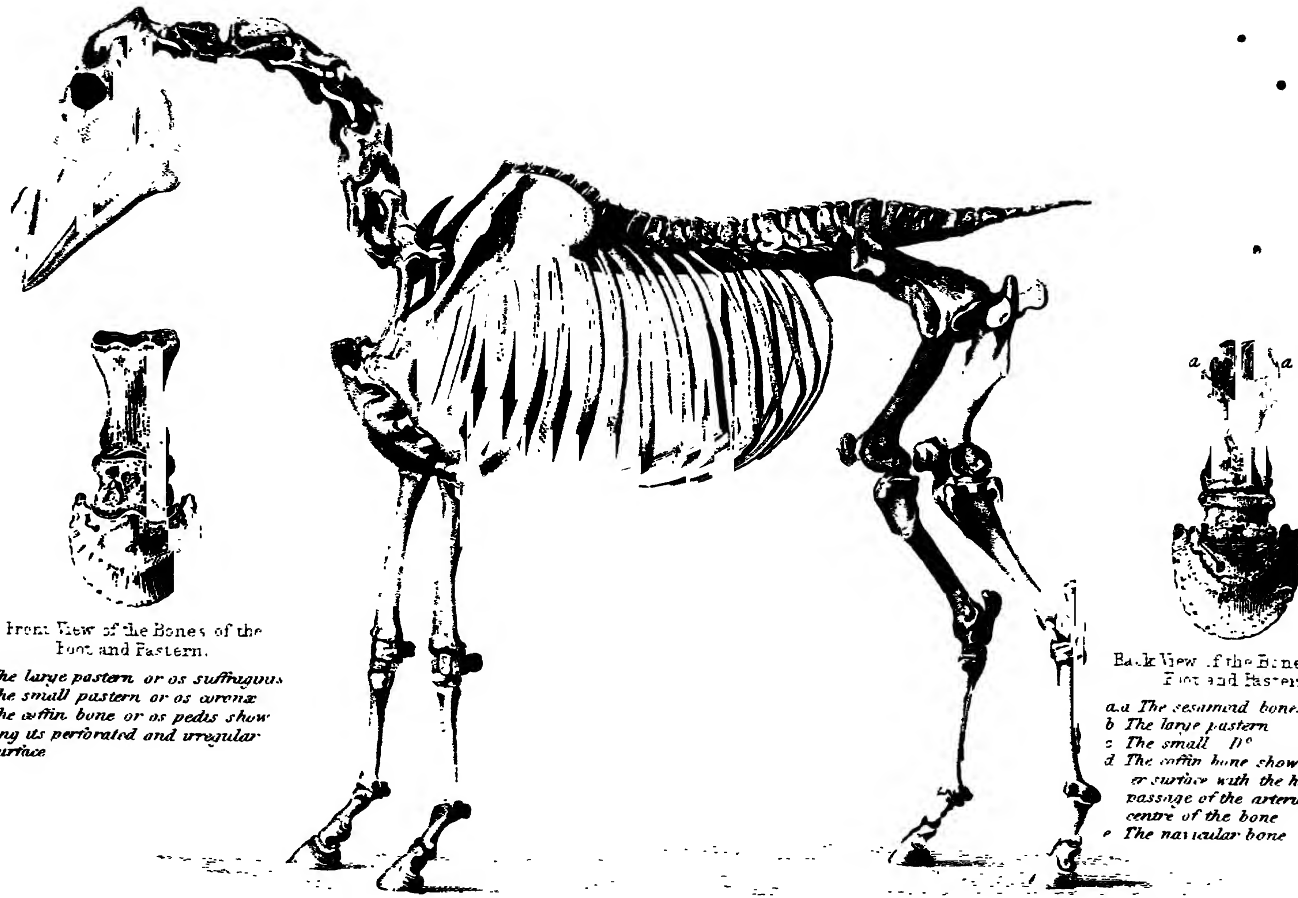




11 Horizontal Escapement.



12 Duplex Escapement



Front View of the Bones of the Foot and Pastern.

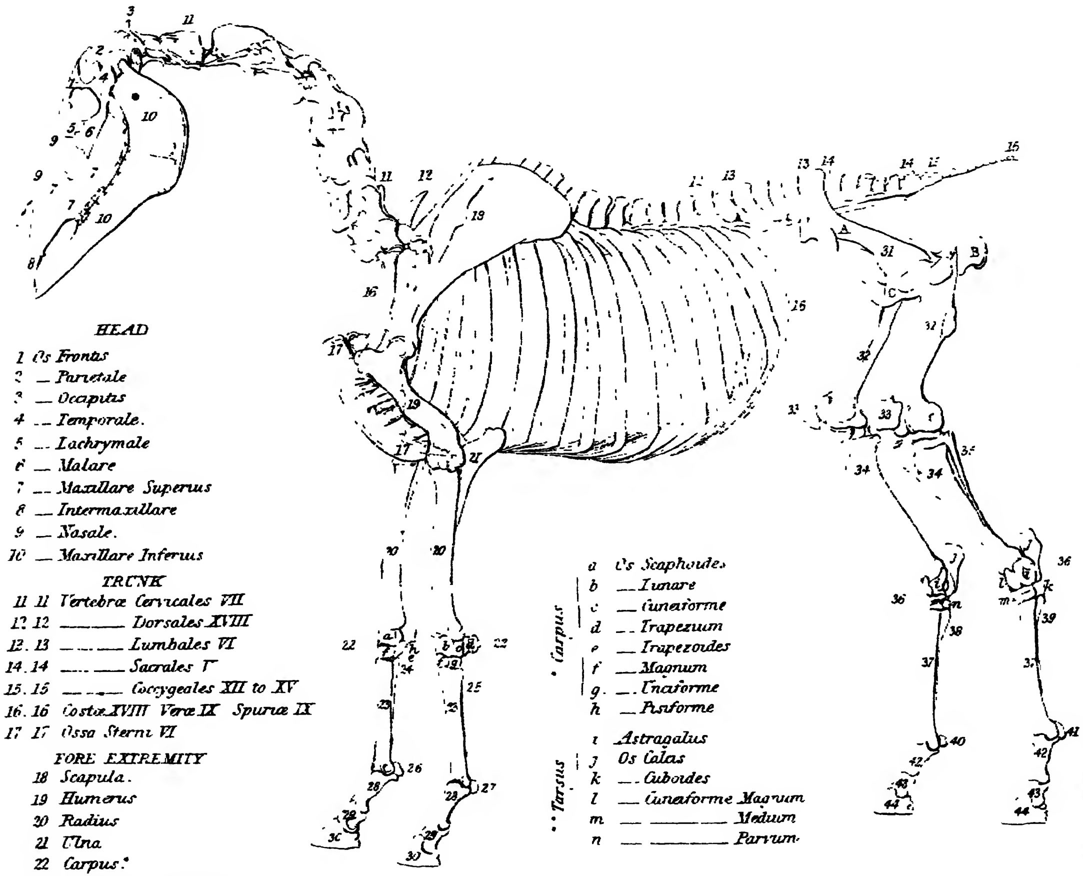
b The large pastern or os suffraginis
c The small pastern or os coronæ
d The coffin bone or os pedis shewing its perforated and irregular surface

Back View of the Bones of the Foot and Pastern

a.a The sesamoid bones
b The large pastern
c The small D°
d The coffin bone showing its lower surface with the holes for the passage of the arteries to the centre of the bone
e The navicular bone

'RA. ȜE ꞩELE HORSE

HORSE.



HEAD

1 Os Frontis
2 — Parietale
3 — Occipitis
4 — Temporale.
5 — Lachrymale
6 — Malare
7 — Maxillare Superius
8 — Intermaxillare
9 — Nasale.
10 — Maxillare Inferius

TRUNK

11 11 Vertebræ Cervicales VII
12 12 ——— Dorsales XVIII
13 13 ——— Lumbales VI
14 14 ——— Sacrales V
15 15 ——— Coccygeales XII to XV
16 16 Costæ XVIII Veræ IX Spuriæ IX
17 17 Ossa Sterni VI

FORE EXTREMITY

18 Scapula.
19 Humerus
20 Radius
21 Ulna
22 Carpus.*
23 Os Metacarpi magnum
24 ——— internum
25 ——— externum.

* Carpus

a Os Scaphoides
b — Lunare
c — Cuneiforme
d — Trapezium
e — Trapezoides
f — Magnum
g — Unciforme
h — Pisiforme

** Tarsus

i Astragalus
j Os Calcis
k — Cuboides
l — Cuneiforme Magnum
m ——— Medium
n ——— Parvum.

FORE EXTREMITY continued.

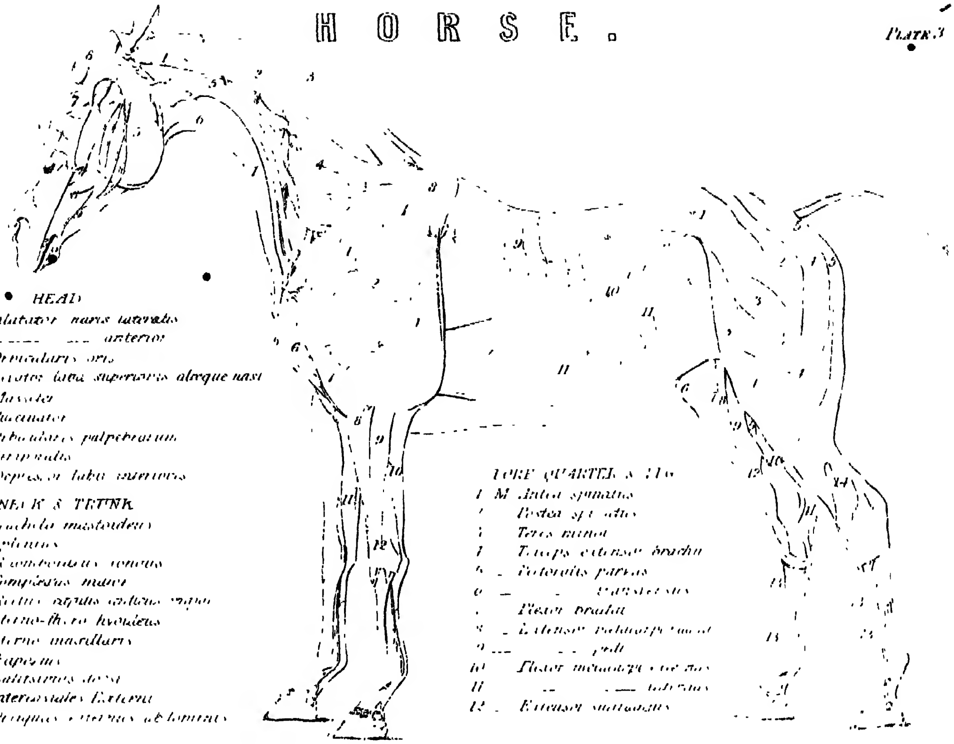
26 Os Sessamoideum internum
27 — ——— externum
28 Os Suffraginis
29 — Coronæ
30 — Pedis The Os Naviculare is placed behind the joint of the last two bones and cannot therefore be seen.

HIND EXTREMITY.

31 Pelvis
A. Ilium B. Ischium C. Pubis.
32 Os Femoris
33 Patella
34 Tibia
35. Fibula
36 Tarsus**
37 Metatarsi magnum
38 ——— internum.
39 ——— externum
40 Os Sessamoideum internum
41. — ——— externum
42 Os Suffraginis
43 — Coronæ
44 — Pedis Os Naviculare as in fore foot

Vol. 7

HORSE.



HEAD

1 M Dilatator naris lateralis
2 — — anterior
3 Orbicularis oris
4 Levator labii superioris alæque nasi
5 Masseter
6 Buccinator
7 Orbicularis palpebrarum
8 Temporalis
9 — Depressor labii inferioris

NECK & TRUNK

1 M Trachelo mastoideus
Splenius
[illegible] Rhomboideus longus
4 Complexus major
5 — Rectus capitis anticus major
6 — Sterno-thyro hyoideus
7 Sterno maxillaris
8 Trapezius
9 Latissimus dorsi
10 Intercostales Externi
11 Obliquus externus abdominis

FORE QUARTER & LEG

1 M Antea spinatus
2 Postea spinatus
3 Teres minor
4 Triceps extensor brachii
5 — Pectoralis parvus
6 — — [illegible]
7 Flexor brachii
8 — Extensor metacarpi magnus
9 — — — pedis
10 Flexor metacarpi externus
11 — — — internus
12 — Extensor suffraginis

HIND QUARTER & LEG

1 M [illegible]
2 — — [illegible]
3 [illegible]
4 — Biceps Abductor
5 — [illegible]
6 Rectus
7 [illegible]
8 [illegible]
9 [illegible]
a — Gastrocnemius internus
b Plantaris
c Flexor metatarsi
d Extensor pedis
e Flexor pedis

In this cut the Panniculus carnosus [illegible] have been removed

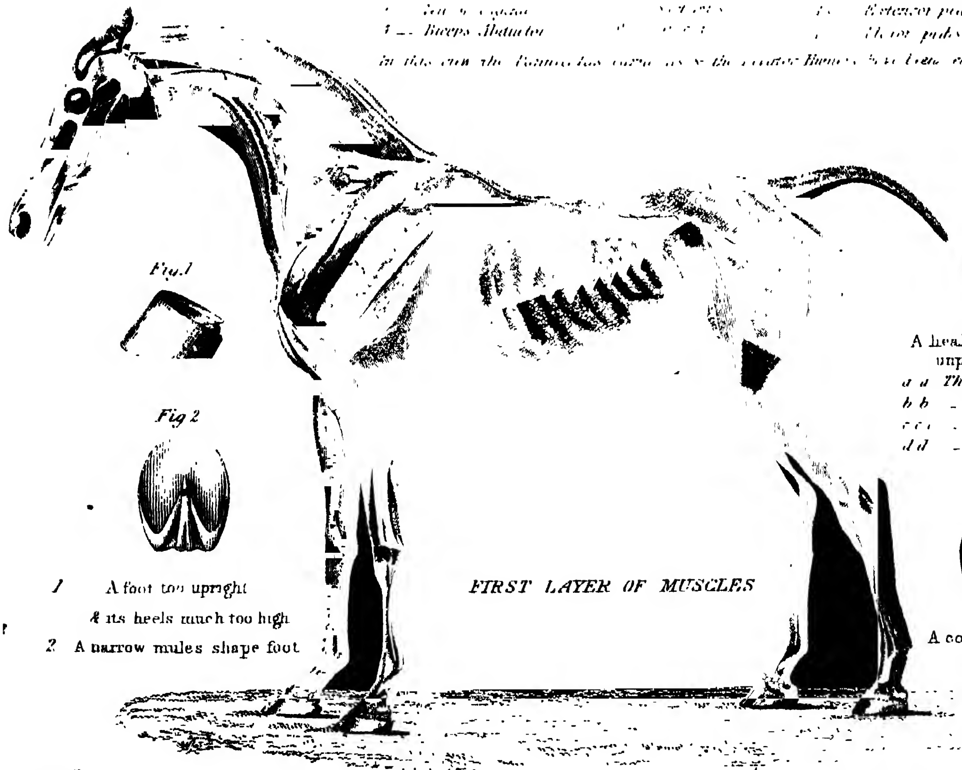


Fig. 1

Fig 2

1 A foot too upright
& its heels much too high
2 A narrow mules shape foot

FIRST LAYER OF MUSCLES

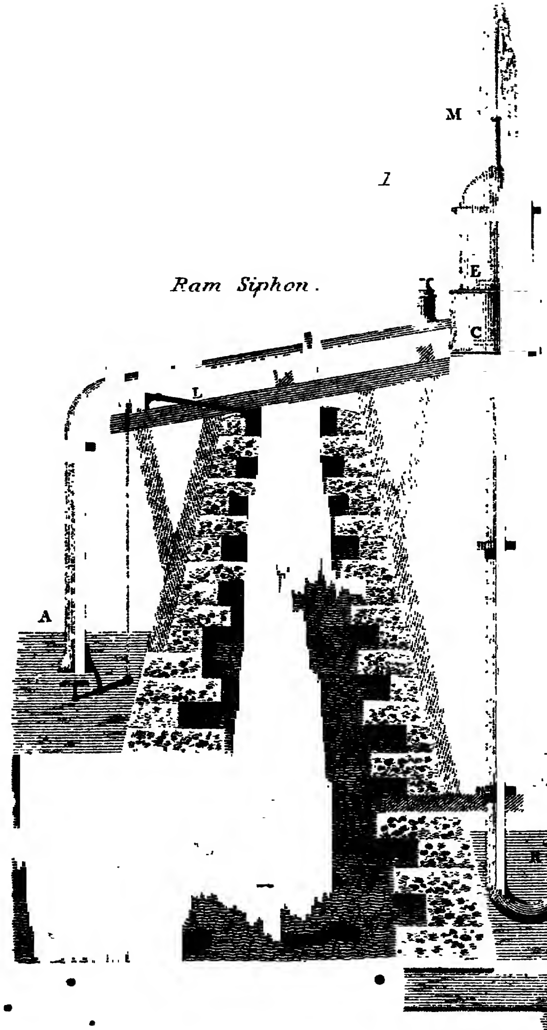
Fig 3

A healthy foot in an unpared state
a a The frog
b b — bars
c c c — sole
d d — seat of corns

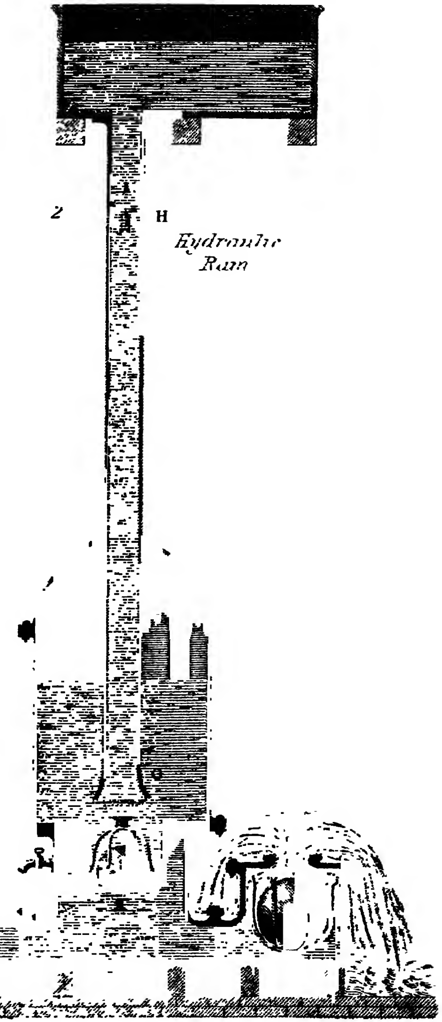
Fig 4

A contracted Foot

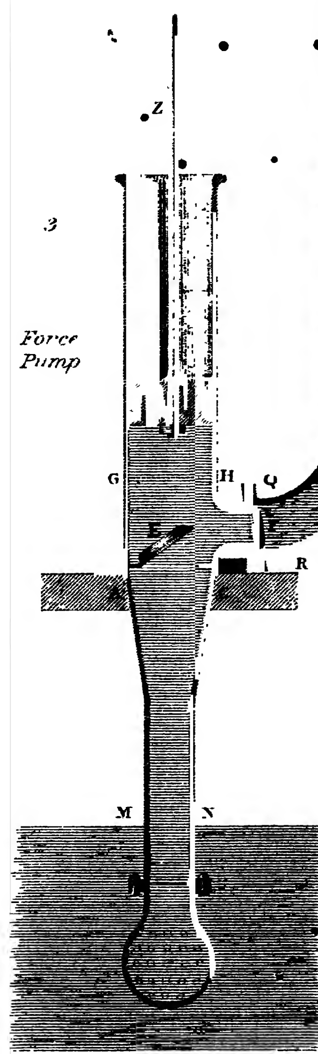
HYDRAULICS.



1 Ram Siphon.

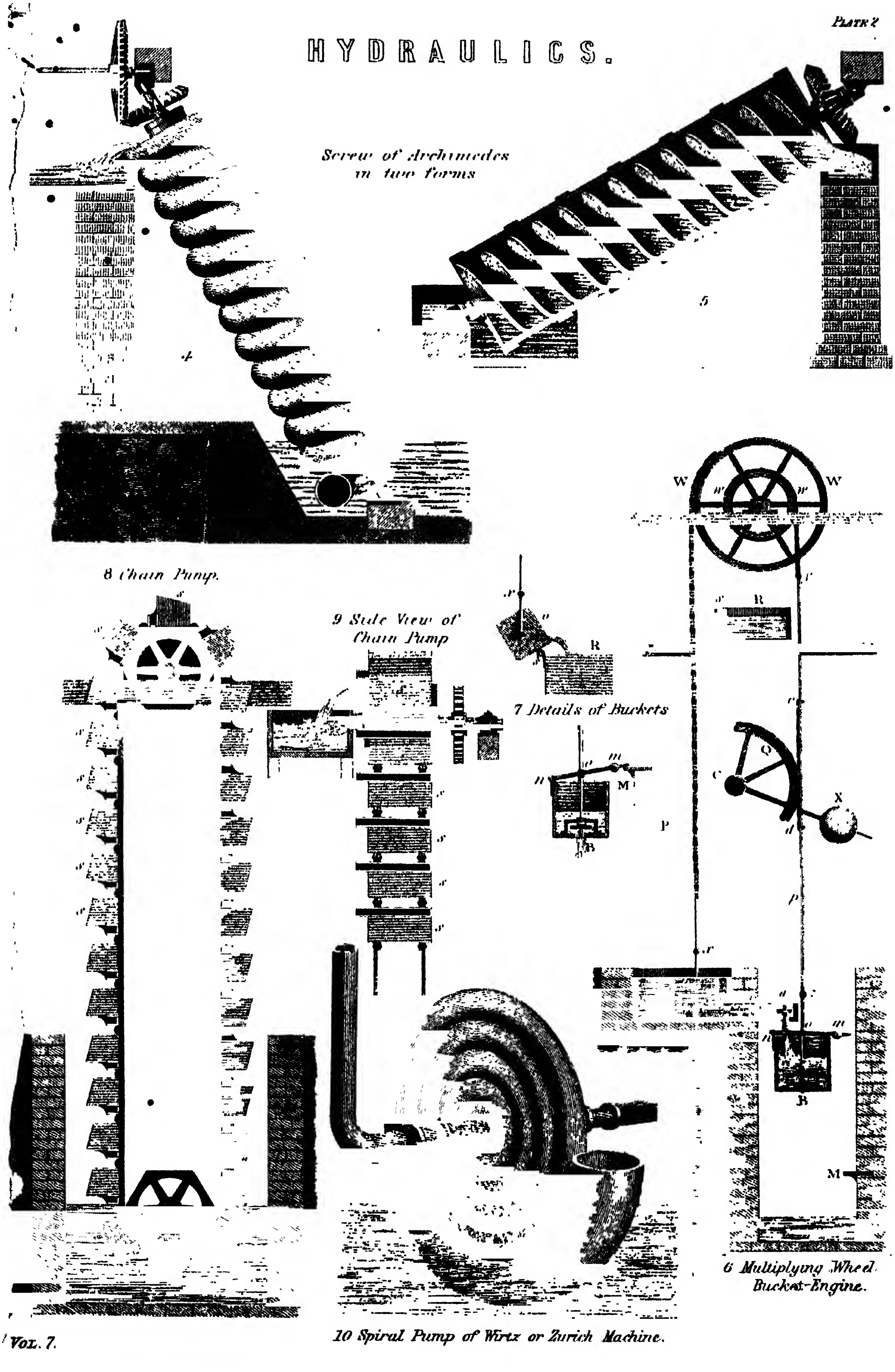


2 Hydraulic Ram

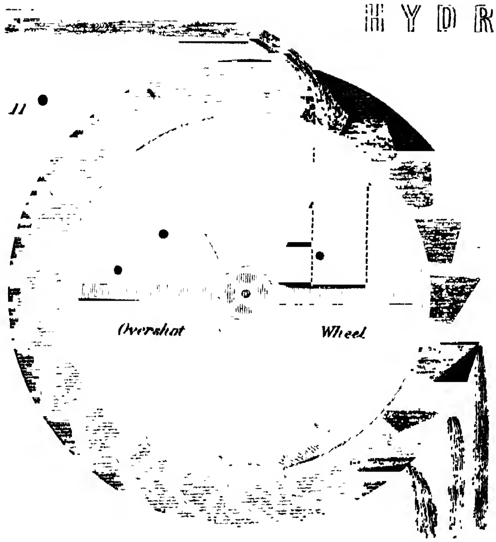


3 Force Pump

HYDRAULICS.


Screw of Archimedes
in two forms
4
5
8 Chain Pump.
9 Side View of
Chain Pump
7 Details of Buckets
R
M
P
B
W
W
Q
C
X
M
B
6 Multiplying Wheel
Bucket-Engine.
10 Spiral Pump of Wirtz or Zurich Machine.

11



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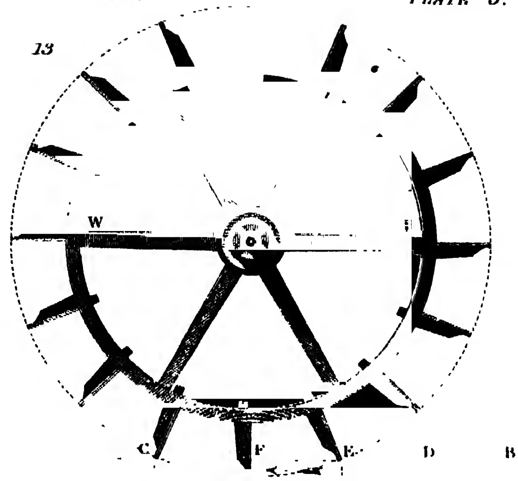

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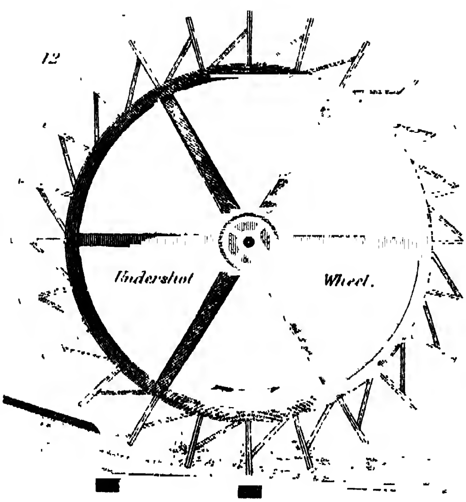

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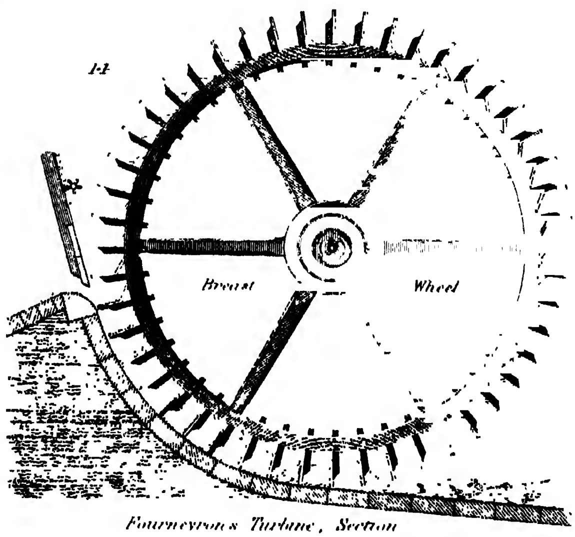
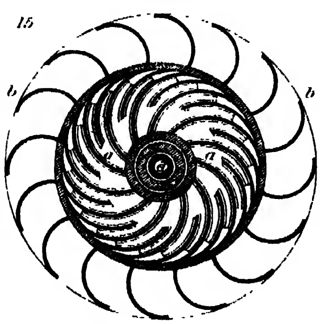


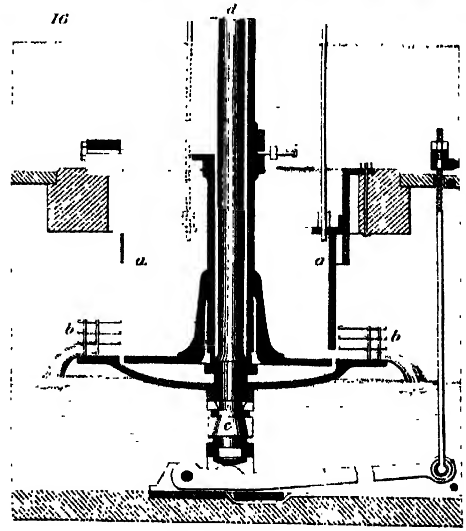
Fourneyron's Turbine, Plan

15



Fourneyron's Turbine, Section

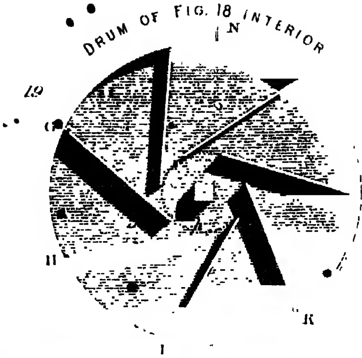
16

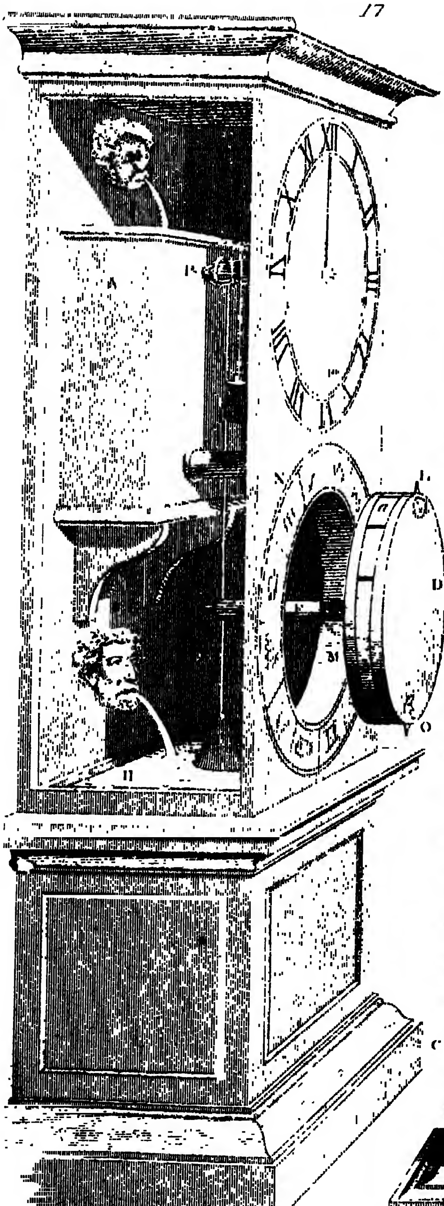


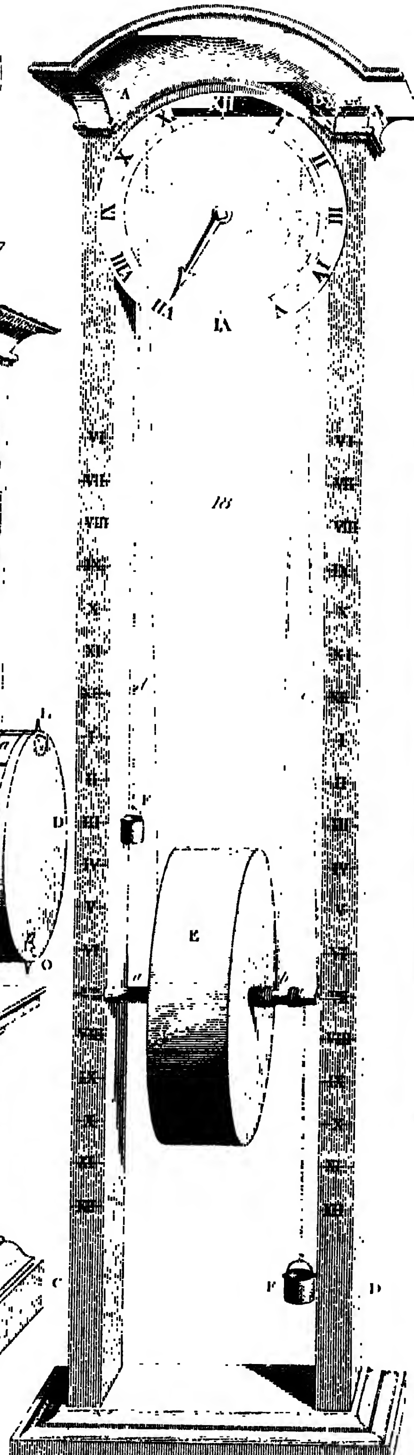
HYDRAULICS.

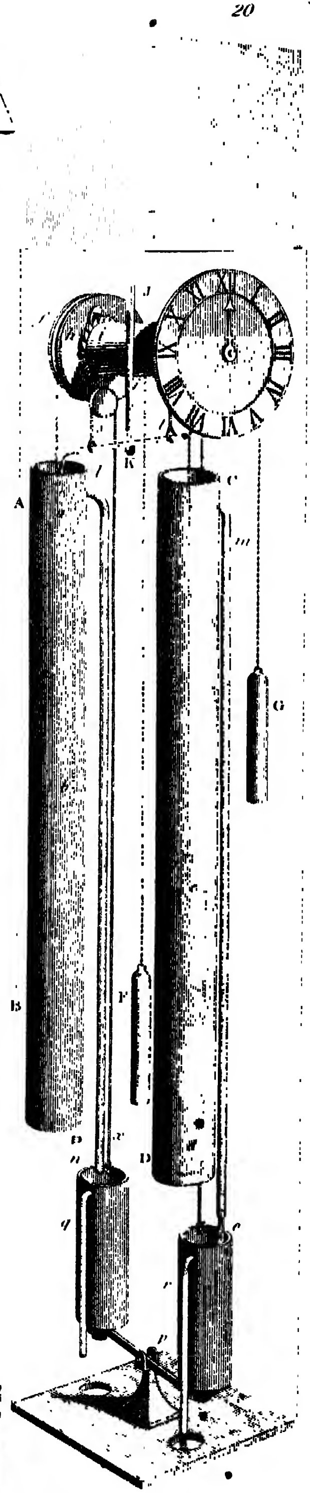
PLATE 4.

(HYDRAULIC CLOCKS OR CLEPSYDRÆ)

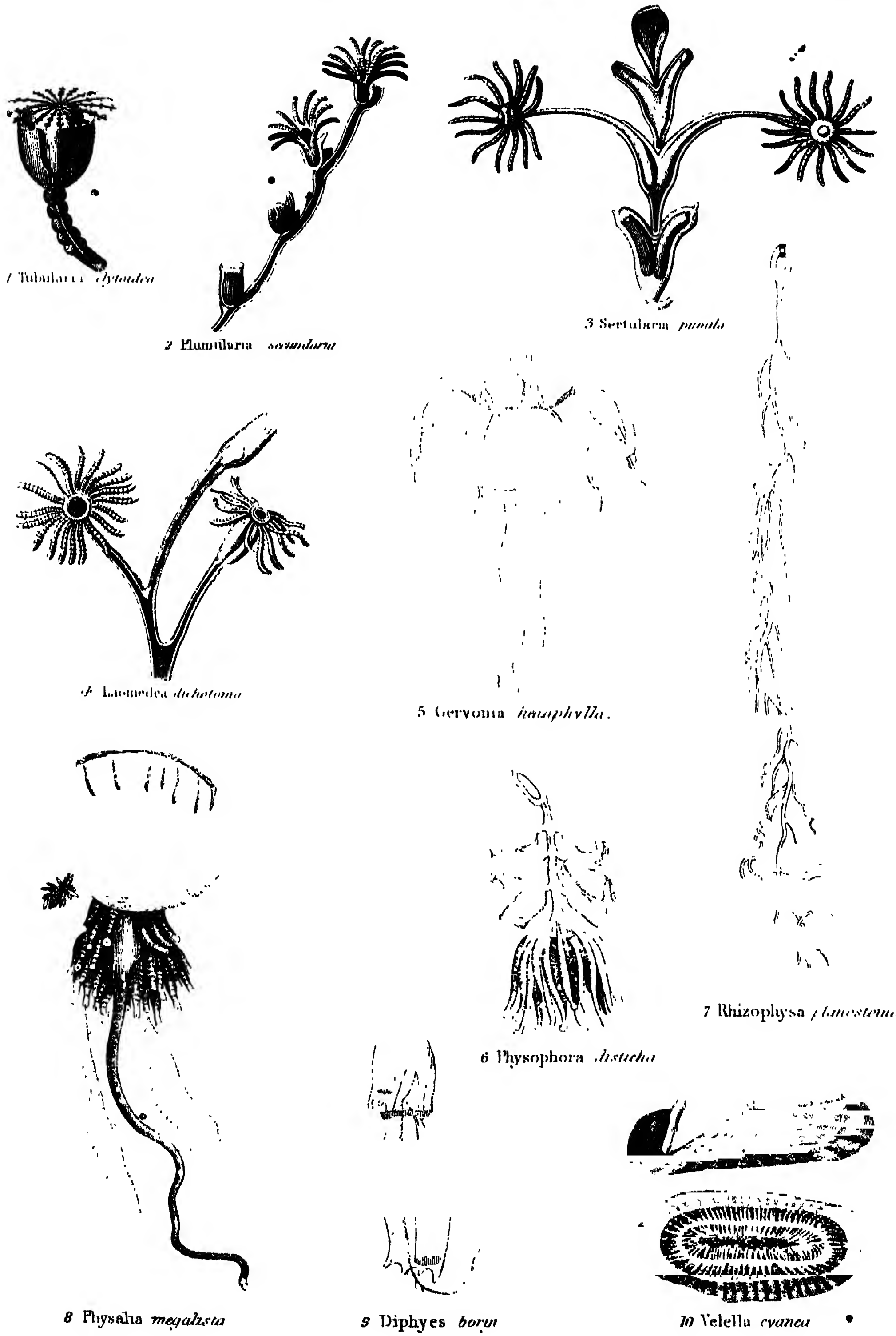








7.



1 Tubularia clytoidea

2 Plumularia secundaria

3 Sertularia pumila

4 Laomedea dichotoma

5 Geryonia hexaphylla.

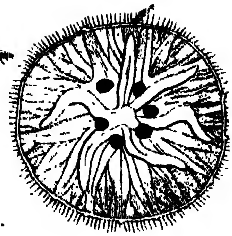
6 Physophora disticha

7 Rhizophysa planestoma

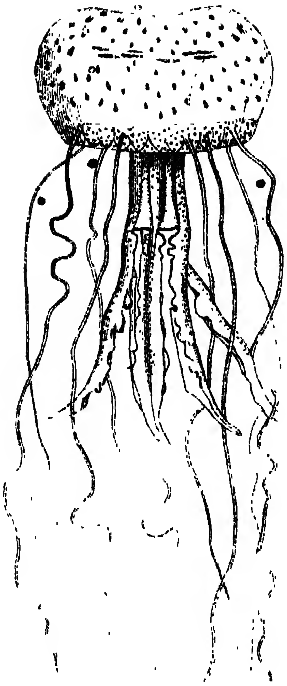
8 Physalia megalista

9 Diphyes borui

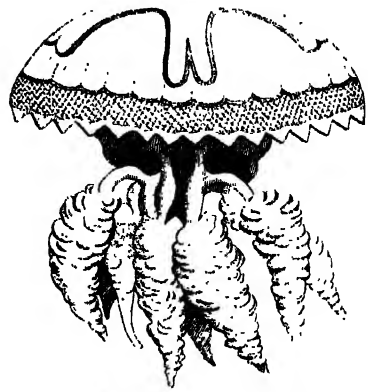
10 Velella cyanea



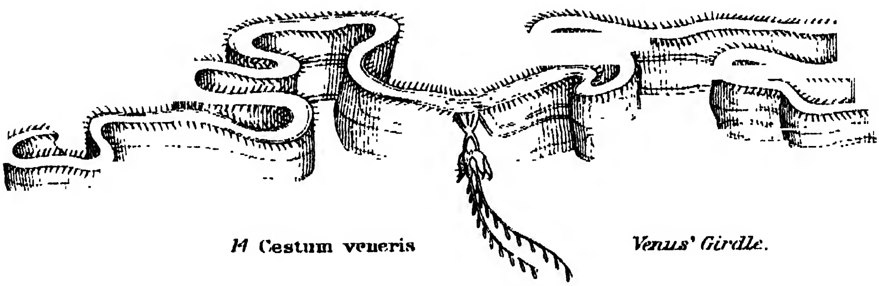
11 Aurelia *aurita*.



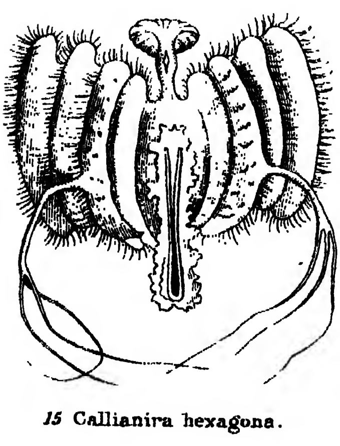
12 Pelagia *planospura*



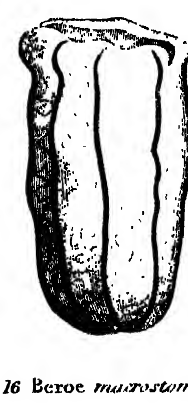
13 Rhizostoma *cuvieri*



14 Cestum veneris *Venus' Girdle.*

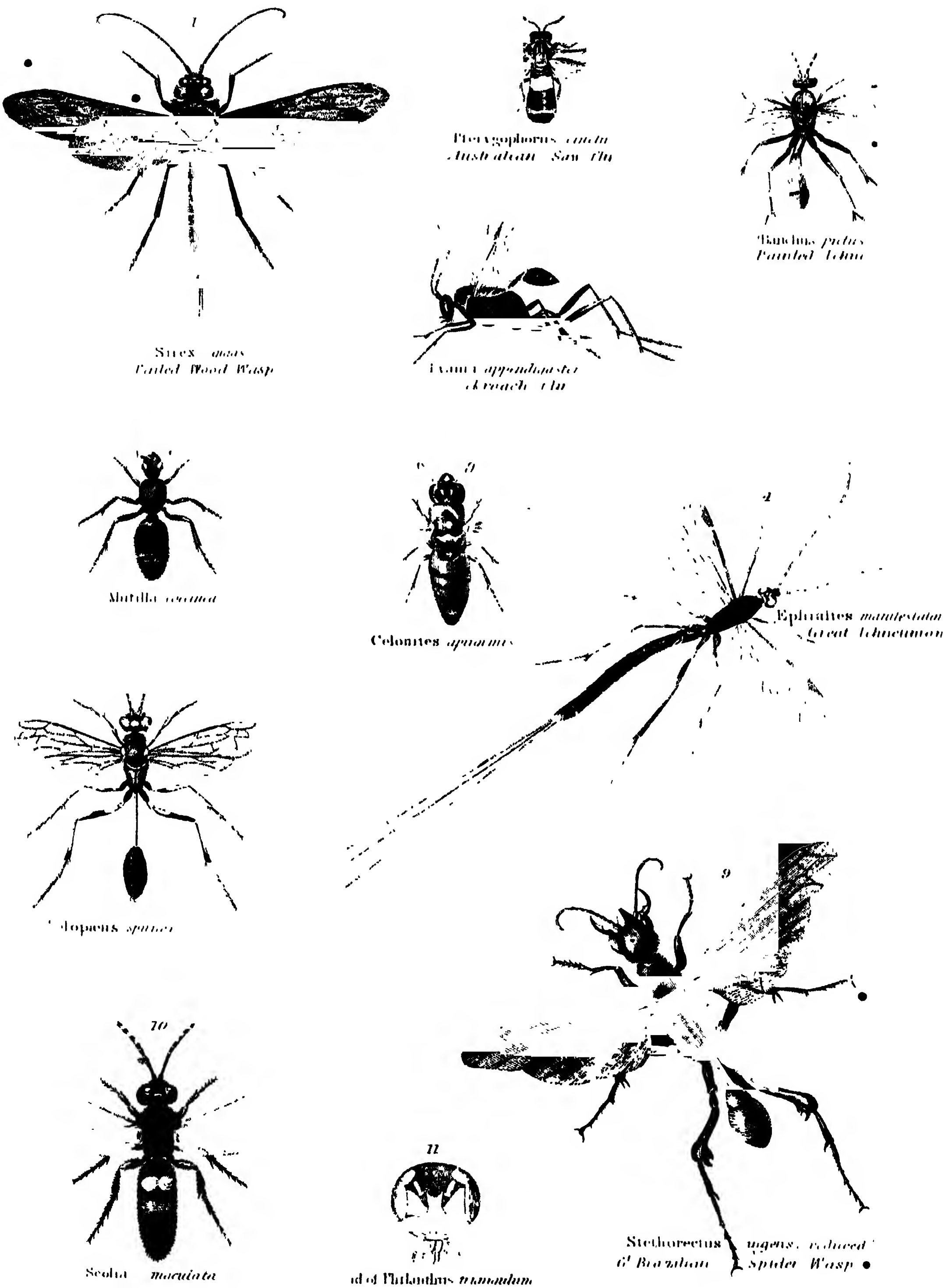


15 Callianira hexagona.



16 Beroe *macrostoma*

HYMENOPTERA.



Sirex *gigas*
Tailed Wood Wasp

Pterygophorus *cincta*
Australian Saw Fly

Banchus *pictus*
Painted Ichn

Evania *appendigaster*
Cockroach Fly

Mutilla *coccinea*

Celonites *apiformis*

Ephialtes *manifestator*
Great Ichneumon

Pelopeus *spinifex*

Stethorectus *ingens*, *reduced*
G^t Brazilian Spider Wasp

Scolia *maculata*

…d of Philanthus *triangulum*

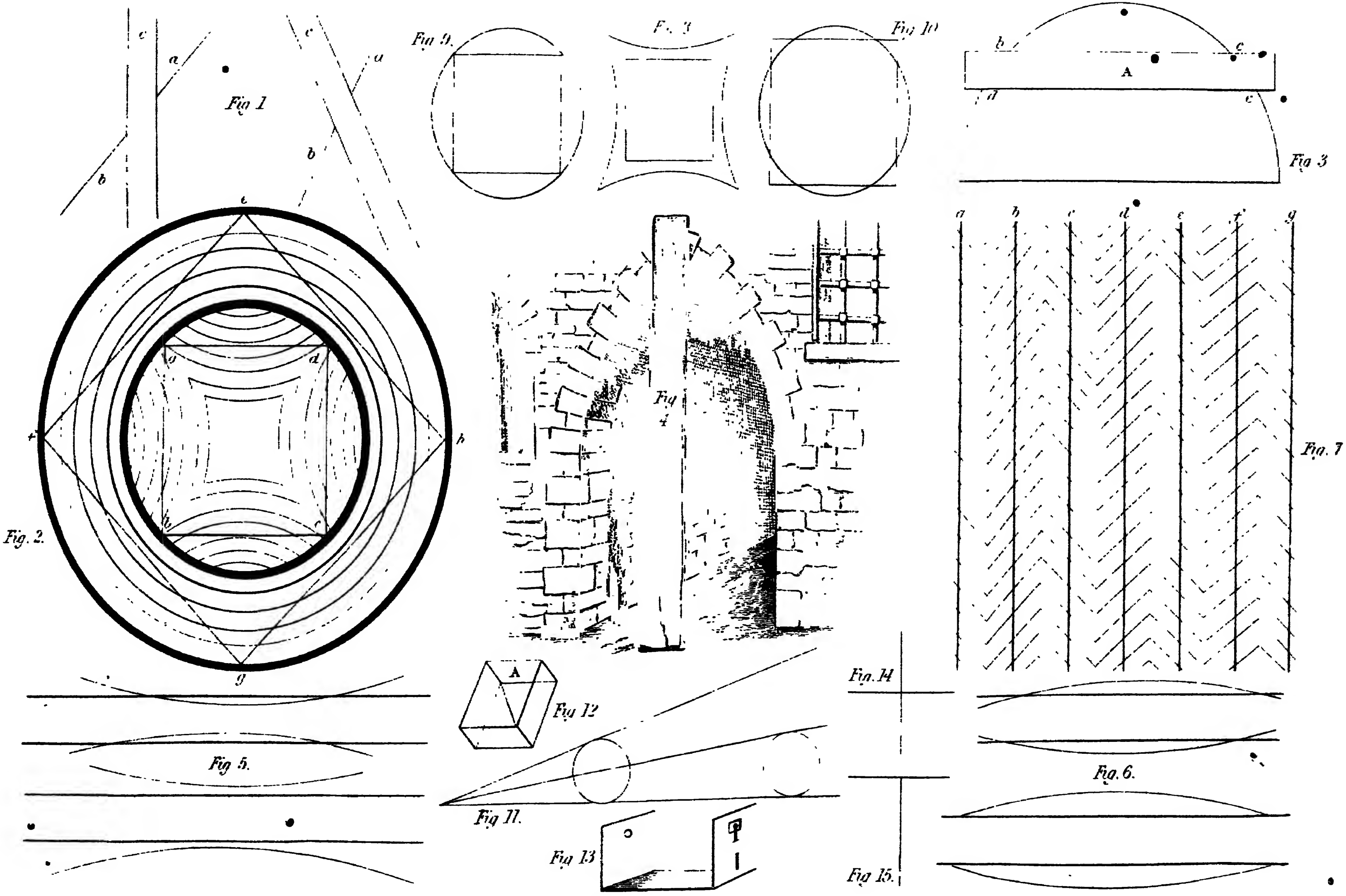
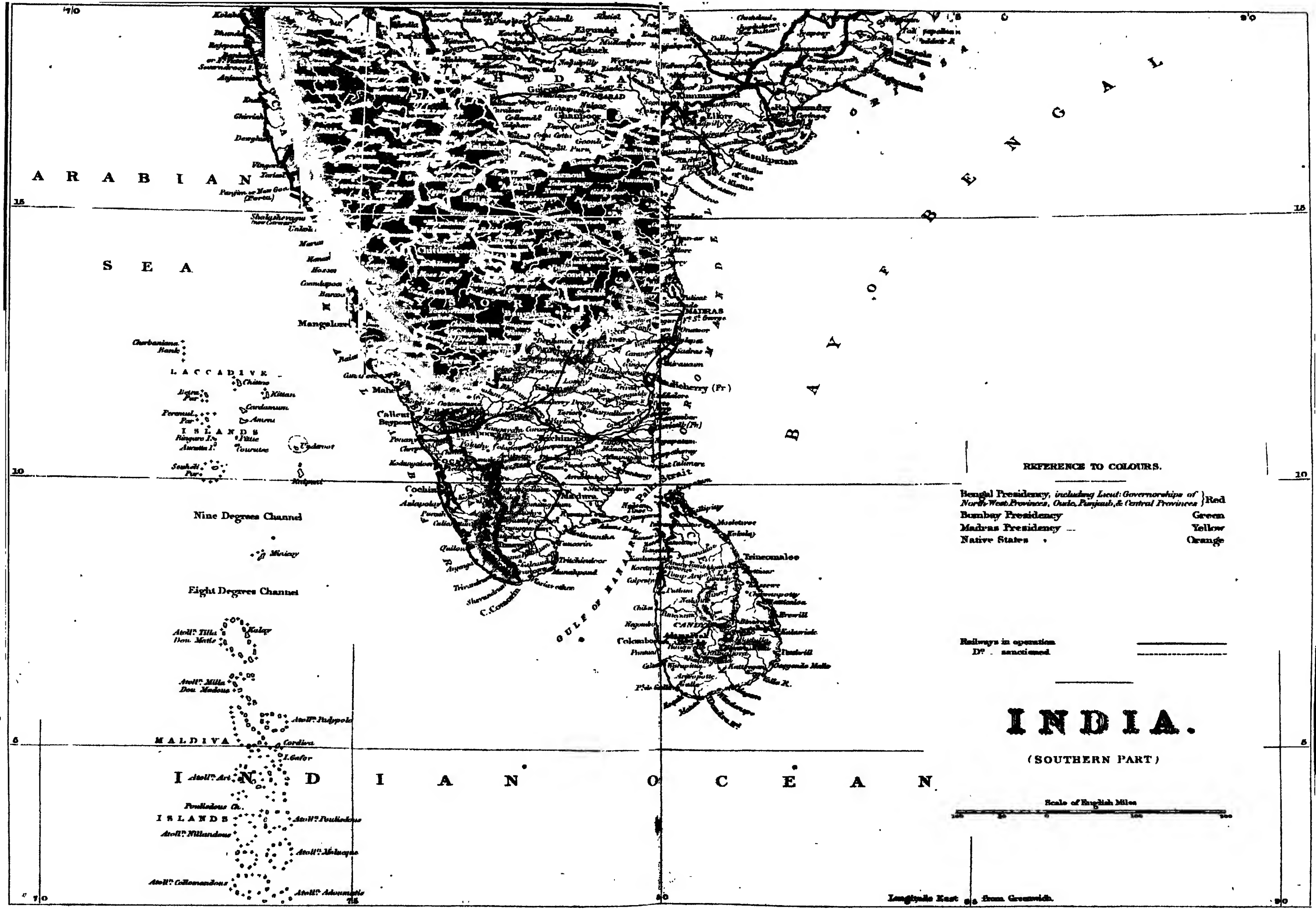


Fig 1
Fig. 2.
Fig 3
Fig 4
Fig 5.
Fig. 6.
Fig. 7
Fig 9.
Fig 10
Fig 11.
Fig 12
Fig 13
Fig. 14
Fig 15.
A

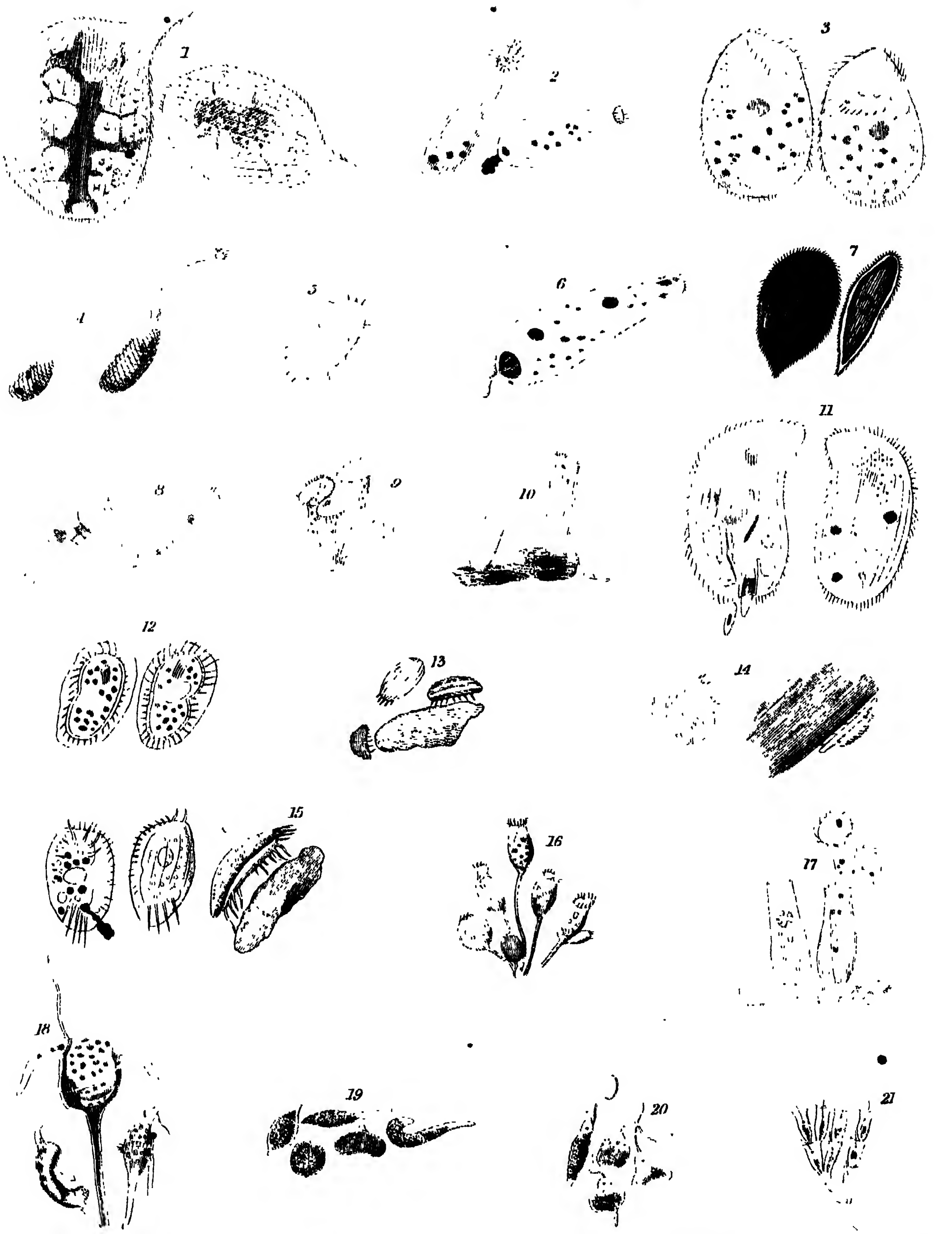

INDIA.
(NORTHERN PART)
Scale of English Miles
REFERENCE TO COLOURS.
Bengal Presidency, including Lieut. Governorships of North-West Provinces, Oude, Punjaub, & Central Provinces Red
Bombay Presidency Green
Madras Presidency Yellow
Native States Orange
RAJPOOTANA
BELOOCHISTAN
BAY OF BENGAL.
Longitude East from Greenwich



ARABIAN SEA
BAY OF BENGAL
INDIAN OCEAN
LACCADIVE ISLANDS
MALDIVA ISLANDS
Nine Degrees Channel
Eight Degrees Channel
Gulf of Manaar
Mangalore
Cochin
Madras
Trincomalee
Colombo
C. Comorin
Masulipatam
REFERENCE TO COLOURS.
Bengal Presidency, including Lieut: Governorships of North West Provinces, Oude, Punjaub, & Central Provinces } Red
Bombay Presidency Green
Madras Presidency Yellow
Native States Orange
Railways in operation
D°. sanctioned
INDIA.
(SOUTHERN PART)
Scale of English Miles
Longitude East from Greenwich.

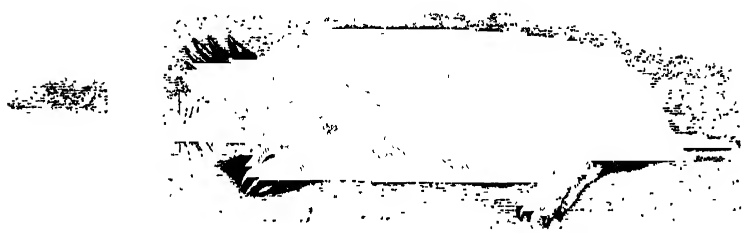
INFLORESCENCE

INFUSORIA.



1. Trachelius, *ovum*.
2. Enchelys, *pupa*.
3. Leucophrys, *patula*.
4. Lachrymaria, *proteus*.
5. Coleps, *incurvus*.
6. Nassula, *elegans*.
7. Ophryoglena, *acuminata*.
8. Cyclidium, *glaucoma*.
9. Stentor, *mülleri*.
10. Tintinnus, *inquilinus*.
11. Chilodon, *cucullulus*.
12. Chlamydodon, *mnemosyne*.
13. Oxytricha, *caudata*.
14. Aspidisca, *denticulata*.
15. Euplotes, *charon*.
16. Vorticella, *microstoma*.
17. Vaginicola, *chrystallina*.
18. Ceratium, *tripos*.
19. Astasia, *hæmatodes*.
20. Euglena, *viridis*.
21. Dinobryon, *sertularia*.

Erinaceus europaeus Common Hedgehog



Talpa europæa Common Mole

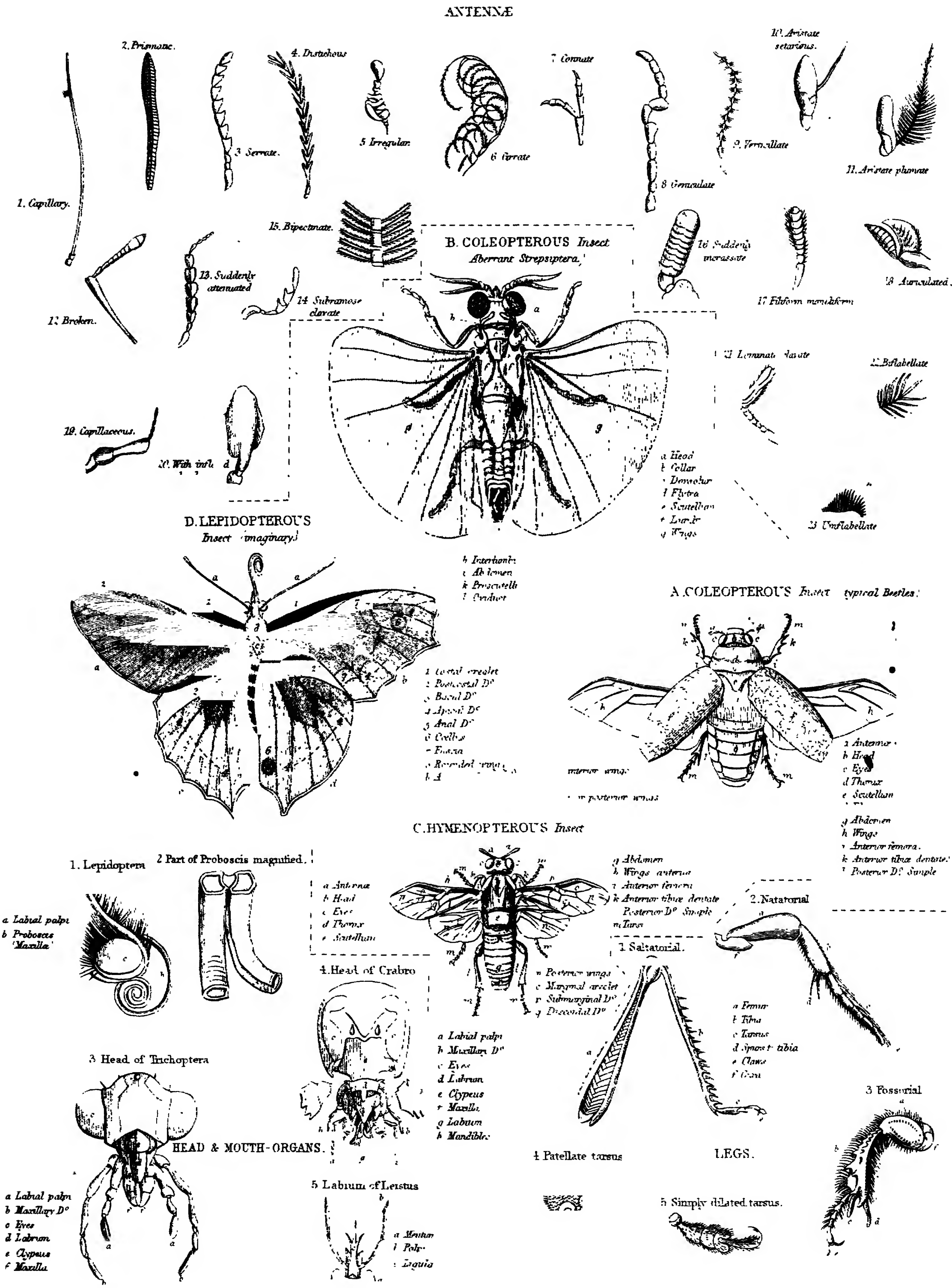
3

Crocidura araneu.__ Garden Shrew.

4

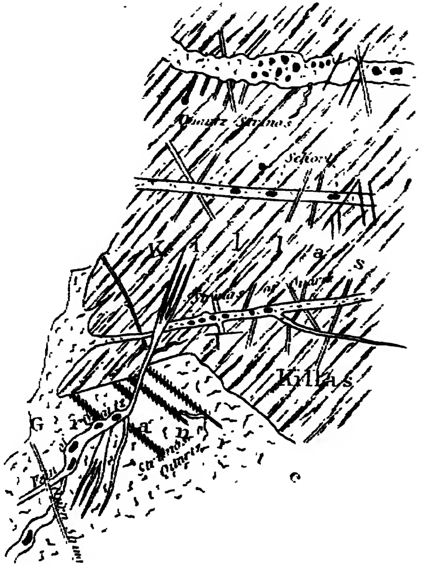
Galeopithecus volans.

INSECTS.


ANTENNÆ
1. Capillary.
2. Prismatic.
3 Serrate.
4. Distichous
5 Irregular.
6 Cirrate
7 Connate
8 Geniculate
9. Verticillate
10. Aristate setarious.
11. Aristate plumate
12 Broken.
13. Suddenly attenuated
14 Subramose clavate
15. Bipectinate.
16 Suddenly incrassate
17 Filiform moniliform
18 Auriculated.
19. Capillaceous.
20. With infl.
22. Biflabellate
23 Uniflabellate
B. COLEOPTEROUS Insect
Aberrant Strepsiptera.
a Head
b Collar
d Elytra
e Scutellum
g Wings
D. LEPIDOPTEROUS
Insect (imaginary.)
h Interhumb.
i Abdomen
k Proscutell.
A. COLEOPTEROUS Insect (typical Beetles.)
1 Costal areolet
2 Postcostal D°
3 Basal D°
4 Apical D°
5 Anal D°
6 Cellule
a Antennæ
b Head
c Eyes
d Thorax
e Scutellum
g Abdomen
h Wings
i Anterior femora.
k Anterior tibiæ dentate.
l Posterior D° Simple
C. HYMENOPTEROUS Insect
a Antennæ
b Head
c Eyes
d Thorax
e Scutellum
g Abdomen
h Wings anterior
i Anterior femora
k Anterior tibiæ dentate
Posterior D° Simple
m Tarsi
n Posterior wings
o Marginal areolet
p Submarginal D°
q Discoidal D°
1. Lepidoptera
a Labial palpi
b Proboscis (Maxillæ)
2 Part of Proboscis magnified.
3 Head of Trichoptera
a Labial palpi
b Maxillary D°
c Eyes
d Labrum
e Clypeus
f Maxillæ
4. Head of Crabro
a Labial palpi
b Maxillary D°
c Eyes
d Labrum
e Clypeus
f Maxillæ
g Labium
h Mandibles
HEAD & MOUTH-ORGANS.
5 Labium of Leistus
a Mentum
b Palpi
c Ligula
1 Saltatorial.
2. Natatorial
a Femur
b Tibia
c Tarsus
d Spur of tibia
e Claws
3 Fossorial
4 Patellate tarsus
LEGS.
5 Simply dilated tarsus.

INTRUSIVE ROCKS.

1



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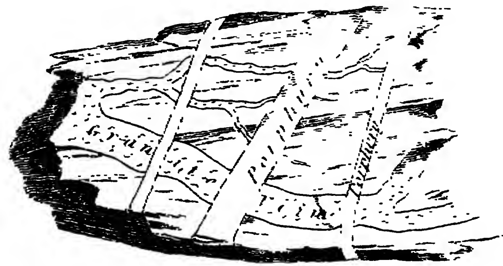

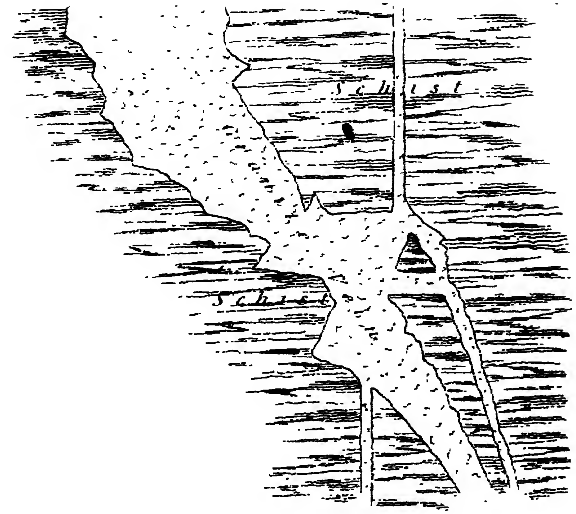

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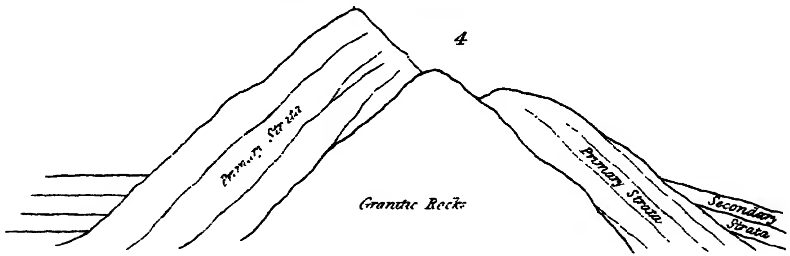

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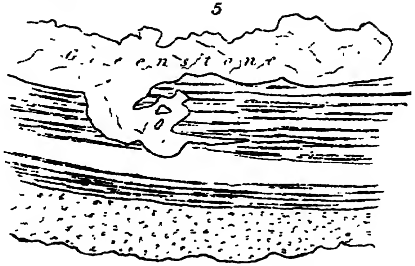

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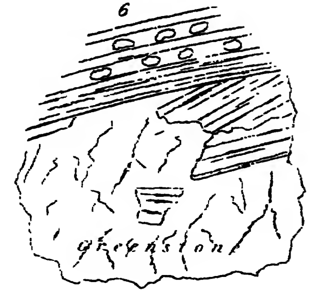

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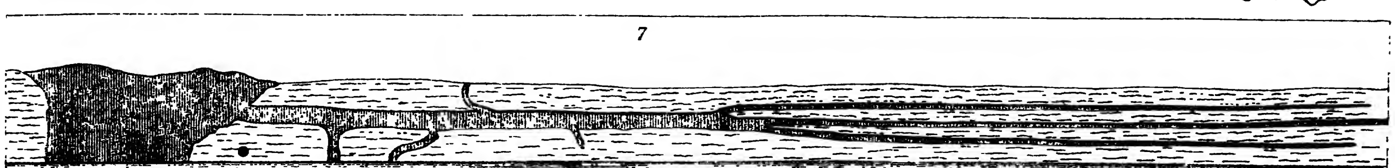
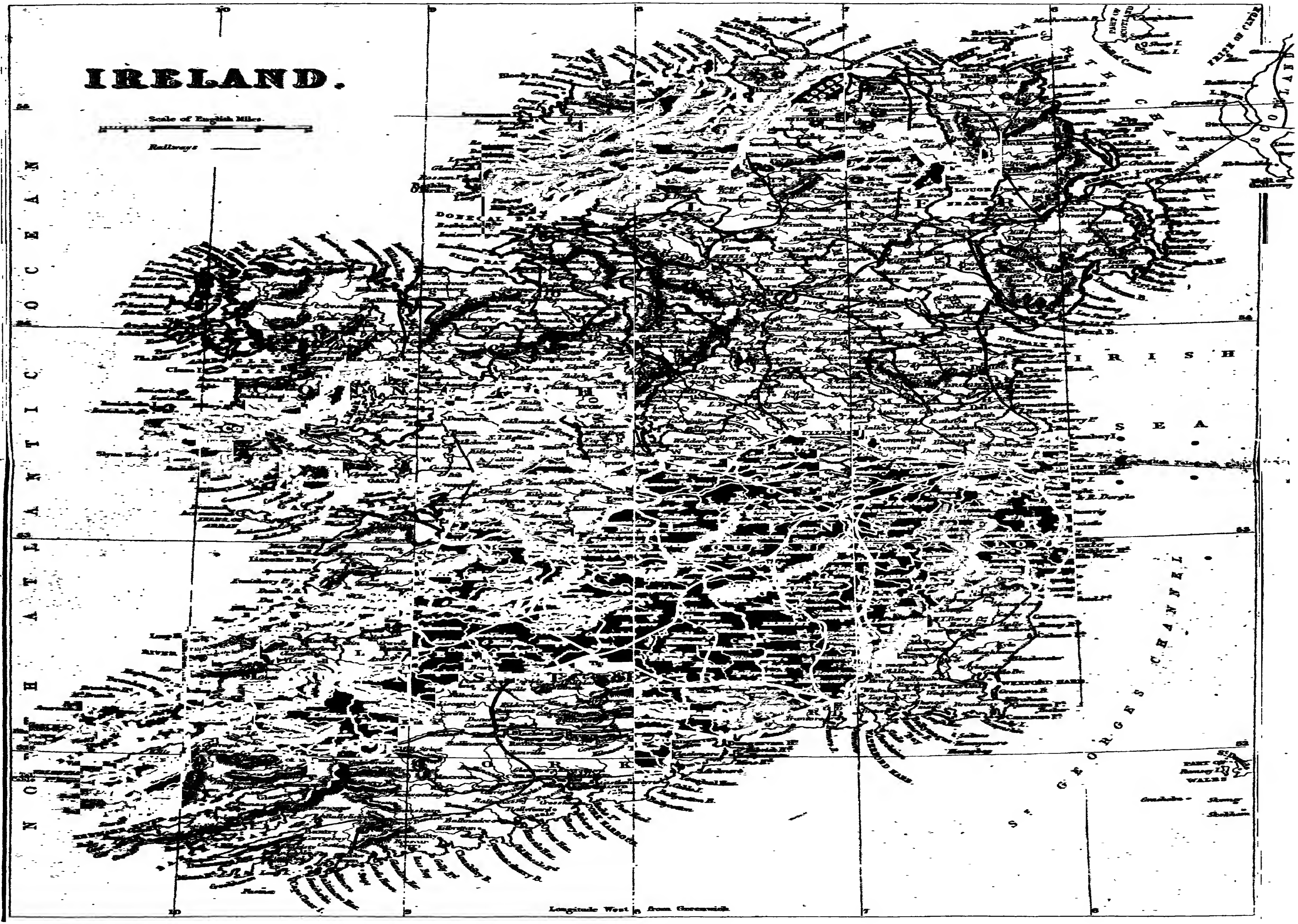


Intrusive Sheet of Trap. Trotternish Isle of Skye.



IRELAND.
Scale of English Miles.
Railways
NORTH ATLANTIC OCEAN
IRISH SEA
ST. GEORGES CHANNEL
NORTH CHANNEL
PART OF SCOTLAND
FRITH OF CLYDE
PART OF WALES
DONEGAL BAY
DUNDALK BAY
BELFAST LOUGH
WEXFORD HARB.
WATERFORD HARB.
CORK HARBOUR
Longitude West from Greenwich

LIST OF PLATES.

VOL. VII.

To be Bound at Commencement of Volume in Following Order.

THE NATIONAL ENCYCLOPÆDIA:

A DICTIONARY OF

UNIVERSAL KNOWLEDGE.

HAKE (Merlucius) is a genus of fishes belonging to the important family GADIDÆ. This genus has only two dorsal fins and one anal, and so is at once distinguished from the typical genus Gadus, containing the cod, haddock, &c., which has three dorsals and two anals. It is distinguished from the burbots (Lota) and rocklings (Motella) and some other members of the Gadidæ by the absence of a barbel on the chin. The ventral fins are well developed, and there is a separate caudal fin. The body is long, covered with very small scales. There are teeth in the jaws and on the vomer. The Common Hake (*Merlucius vulgaris*) is abundant on the western and southern coasts of Britain; it occurs on the coasts of Europe and North America. It attains a length of from 3 to 4 feet, and sometimes weighs as much as 22 lbs. This fish is very voracious, preying chiefly on herrings and pilchards. The flesh of the hake is considered to be rather coarse; it proves a useful article of food when salted and dried. During the spawning season, from January to April, the hake keeps near the bottom, and is then taken by the trawl-net. At other seasons it is generally taken by lines. The body is grayish-brown above, whitish beneath. Several other species are found near the coasts of Chili and New Zealand.

HAK'LUYT, RICHARD, born in 1553, studied at Westminster School and at Christ Church, Oxford, and applied himself particularly to geography, or cosmography, as it was then called, and was made a lecturer on that subject at Oxford. About 1584 he went to Paris with Sir Edward Stafford, ambassador of Queen Elizabeth, where he remained five years. On his return to England he was made by Sir Walter Raleigh a member of the company of gentlemen adventurers and merchants of London, for the inhabiting and planting "of our people in Virginia," as appears from his "Collection of Travels" (edition of 1589, p. 815), which he published in one volume, folio, and which he afterwards enlarged and published in three volumes, folio (1599–1600), under the title, "The Principal Navigations and Discoveries of the English Nation, by Sea or over Land, to the remote and furthest distant quarters of the earth, at any time within the compass of these 1500 years." Hakluyt also published or edited translations of several foreign narratives of travellers, of which a selection has been since made: "A Selection of curious, rare, and early Voyages and Histories of interesting Discoveries, chiefly published by Hakluyt, or at his suggestion, but not included in his celebrated Compilation" (4to, London, 1812). Hakluyt died in 1616, and was buried in Westminster Abbey. In 1846 a society was formed called "the Hakluyt Society," the object of which is the printing of rare and unpublished voyages and travels, in harmony with the design of Hakluyt.

The Bay of Hakodadi

HAKODA'DI, a seaport town of Japan, on a peninsula on the south shore of Yesso, in Sangar Strait, was opened to commerce in 1858. Trade is carried on chiefly by Russian, American, and British vessels. The exports consist of wood (hardwood, pine, fir, and hinoki), comboo (seaweed), gensen, awabee, dried fish, cuttle-fish, oil, and

silk; the imports of linen, woollen, and cotton stuffs, velvet, and sugar. The value of the imports is about £1,500,000, and of the exports £1,300,000 per annum.

Hakodadi is 650 miles from Jeddo, and has about 15,000 inhabitants. The population of the town and surrounding district has been estimated at 100,000. Hakodadi has been compared in position and aspect to Gibraltar and Hong-Kong, as it stretches 8 miles along the base of a lofty promontory which juts out into the sea. The winters are extremely cold.

HAL'ACAH (Heb., rule, guide) is the general term for an element in the Jewish Talmud, which consists of a series of legal decisions based upon the written laws contained in the Sacred Books. As in modern times the decisions of the courts are preserved as precedents for the interpretation of the statutes, so there grew up round the Jewish law a series of comments and illustrations, and the decisions of the rabbis and councils, by means of which it was adapted to the altering circumstances of the nation. Many of these decisions were traditionally ascribed to Moses, who was supposed to have given an oral as well as a written law to the nation, but they cannot be reasonably ascribed to a period earlier than the captivity. For a long time these traditions were preserved only in the memories of the rabbis, but they were collected and committed to writing by the celebrated Hillel, who died about the year 10 B.C. To the collection additions were made by several subsequent teachers, and the whole was reduced to one general code by Jehuda Hanassi, about 220 A.D., under the name of the MISHNA. This is, as it were, the text of the Talmud, on which the Gemara is the commentary.

HAL'BERD or **HAL'BERT**, a battle-axe, consisting of a strong wooden handle about 6 feet long surmounted by a sort of bill-hook, formerly used for cutting and thrusting, and also for tearing down works against which an attack was made. It was first used in England in the fifteenth century, and was borne up to the end of the eighteenth century by all sergeants of foot, artillery, and marines, and by whole companies in some regiments, called halberdiers. (Derivation, *halb-barth*, "half battle-axe.")

HALE, SIR MATTHEW, was born 1st November, 1609, at Alderley, in the county of Gloucester. Both his parents having died while he was an infant, Matthew Hale was educated, under the direction of a near relation on his mother's side, by a clergyman professing puritanical principles. At the age of seventeen he was removed to Magdalen Hall, Oxford, where he plunged into great dissipation. By accidental circumstances he was introduced to Serjeant Glanvil, who, perceiving his good qualities, persuaded him to apply to the study of the law. He was admitted a student of Lincoln's Inn on the 8th of November, 1629, and immediately commenced a course of arduous study. One of his companions in a debauch having been taken dangerously ill, Hale was so struck with remorse that he gave up his intemperate habits. He was called to the bar some time previous to the commencement of the Civil War. He resolved not to take any part in the political dissensions and contests which then agitated the country, and he steadily kept his resolution. His neutrality was favourable to his interest as an advocate; he was engaged as counsel for the court party in many of the most important state trials, and yet he was constituted counsel to the commissioners deputed by Parliament to treat with the royal commissioners as to the reduction of Oxford. After the execution of Charles I. Hale took the engagement to be true and faithful to the Commonwealth, and accepted the appointment of one of the commissioners for reforming the law. In 1653 he was made one of the judges of the Common Bench. After having discharged the duties of his office with consummate skill and strict impartiality, he suddenly affected to feel scruples of conscience at acting as judge in criminal cases, and refused to preside in the crown courts, though he still continued to administer the law in civil cases. On the death of Cromwell, Hale refused to act under a commission from the Protector Richard. He was a member of the Parliament which recalled Charles II., and was made chief baron of the exchequer in 1660, and knighted. In 1671 he was raised to the chief-justiceship of the King's Bench, where he presided with honour to himself and advantage to the public till 1675, when, from the state of his health, he resigned his office. He died from dropsy on Christmas Day, 1676.

As a lawyer Hale's reputation is high, and his integrity is unimpeached. The only spot upon his memory as a judge is the fact of his having condemned two women for witchcraft, at the assizes at Bury St. Edmund's, in the year 1665. Hale in the course of the trial avowed himself a believer in witchcraft, and the jury found the prisoners guilty, notwithstanding that many impartial bystanders declared that they disbelieved the charge. The prisoners were executed.

Sir Matthew Hale was a voluminous writer, though none of his productions were printed during his lifetime. His "Pleas of the Crown," "History of the Common Law," and some other treatises connected with the law, were published after his death, and also several others upon scientific and religious subjects. His valuable manuscripts he bequeathed to the society of Lincoln's Inn, and he directed that they should not be lent out or printed.

A catalogue of the manuscripts was contained in his will, and a full account and catalogue of all his works is printed in Dr. Williams' "Life of Hale." His life has also been written by Burnet and Roscoe, and many anecdotes relating to him are detailed by that amusing gossip Roger North, in his "Life of Lord-keeper Guildford."

Sir Matthew Hale was twice married; first to Ann, daughter of Sir Henry Moore, by whom he had ten children; and secondly, late in life, to one of his own domestic servants.

HALEB. See ALEPPO.

HALÉVY, a distinguished French musical composer, of Jewish nationality, whose true name was *Levi*, but who is best known as *Jacques François Fromental Elias Halévy*, was born at Paris in 1799, and died at Nice in 1862. He is best known to the present generation as being the teacher of Gounod, as well as of Ambroise Thomas (author of "Mignon"), of Victor Massé, and of his son-in-law Georges Bizet (author of "Carmen"), four leaders of modern French opera; but it is deeply to be regretted that his beautiful opera "The Jewess" ("La Juive"), once so universally popular, is now known only by fragments, and his bright little comedietta "L'Eclair" seems to be clean forgotten. "La Juive" is even grand in many places, and the composer's nationality has enabled him to give it a *couleur locale* quite unapproachable in its way. He wrote more than twenty other operas, now neglected. Halévy was a pupil of Cherubini at the Conservatoire (gained the Grand Prix de Rome, in 1816), and his successes soon carried him triumphantly back as a master to the door whence he had so recently issued as a diligent student. He remained a professor there to the last. His "methods" are still in use. He was elected to the Institut in 1836, in consequence of the great success of "La Juive," and became permanent secretary to the Academy of Fine Arts in 1854. He was universally respected.

HALF-CLOSE, in music. See CADENCE.

HALF-PAY is an allowance made to military and naval officers, when not actively employed, as a retaining fee, the terms being very different in the navy and army In the latter, half-pay is only granted temporarily to those thrown out of employment by the reduction of the corps with which they are serving, or those who are compelled by ill health to give up active service. In the navy all officers not afloat, whose ship is not in commission, are

placed on the half-pay list until called upon again to serve, and as there were formerly nearly four times as many officers as appointments for them, the list was always very large. To remedy this, a new system was introduced in 1870, by which the numbers have been very greatly reduced. The number of each rank is now limited, and an age is fixed at which every officer is compelled to retire. Retirement, irrespective of age, is also made compulsory on all officers who have not been on active service for a certain time.

HAL'IBUT. See HOLIBUT.

HAL'IDON HILL, the scene of a battle between the English and Scotch, on the 19th of July, 1333, is about a mile from the town of Berwick-upon-Tweed. Edward III. was supporting the claim of Edward Baliol to the crown of Scotland, and was here met by the acting regent of Scotland with a large force. The English charging in a compact body put them to flight with immense slaughter, leaving the flower of the Scottish nobility and 11,000 men on the field, while they sustained but little loss themselves. The result was that Edward Baliol was again put in possession of the throne.

HAL'IFAX, a large manufacturing town in the West Riding of the county of York, in the wapentake of Morley, was created a parliamentary borough by the Reform Act of 1832, and sends two members to the House of Commons. The number of electors averages about 14,500. The population of the borough in 1881 was 73,633; that of the union, comprising twenty townships, 170,418; and that of the parish, one of the most extensive in England (being nearly as large as the whole county of Rutland), 193,684. The town council, by which the municipal borough is governed, consists of forty members, ten of whom are aldermen. Hitherto the mayor has been chosen from among the members.

Halifax, which is 35 miles S.W. of York, 7 miles S.W. of Bradford, and 203 from London, is picturesquely situated among steep hills; the river Hebble skirts the east side of the town, and the borough extends in a westerly direction to the ridge overlooking the Calder Valley. The appearance of the town is generally handsome. In recent years new streets have been opened, old ones widened, houses pulled down and rebuilt in a much superior manner, and some handsome public buildings and large warehouses erected. The sanitary condition of the town has also been improved, and there is an excellent and abundant supply of water. The scenery in the immediate vicinity is of a highly interesting and beautiful character.

The most important public building in Halifax is the magnificent town-hall, which was the last work designed by Sir Charles Barry, and was executed by his son. It is a parallelogram of about 140 feet by 90 feet, and has a tower and spire 175 feet high. The style is Italian Renaissance of a very ornate character, the façade being decorated with statues and carvings suitable to the industrial occupations of the town. The building is constructed of fine local sandstone. The market-hall, formerly called the piece-hall, in which manufacturers used to store their cloths, is a fine quadrangle, containing 315 rooms or warehouses. The hall was handed over to the corporation, in 1868, by Sir Selwin Ibbotson as a gift to the town. There is a fine and spacious old parish church, of pointed Gothic architecture, erected at different dates, and recently restored at considerable cost. There are nine other churches belonging to the Establishment; the most notable is the magnificent Gothic church of All Souls, erected in 1861 by Sir G. Gilbert Scott at the expense of Mr. Edward Akroyd. It is one of the finest modern churches in England, and the expense of erecting and endowing it was over £70,000. It is built of Nottingham limestone and local sandstone, with shafts of granite; Derbyshire or Devonshire marbles, and white and coloured Italian marbles, serpentine, alabaster, and other costly materials are freely used in the construction and decoration. There are numerous statues and carvings both on the exterior and in the interior, a handsome fresco over the chancel, other paintings on the walls, and the whole of the windows are of painted glass. The same gentleman also gave a cemetery 3 acres in extent, together with a beautiful and ornate chapel.

There are nearly forty nonconformist places of worship, many of them elegant and spacious structures. Heath Grammar-school is a fine modern building in Elizabethan style. In an elevated position, commanding an extensive view across the range of hills which divides the two counties of Lancashire and Yorkshire, is the Crossley Orphan Home and School, a noble pile of buildings, in which accommodation is found for 300 children. It was founded in 1864 by the three Crossley brothers, John, Joseph, and Sir Francis; the cost of it was £65,000, and it is endowed with an income of £3000 a year. The sum of £10 a year is paid by the friends of most of the children, who are educated and maintained, the boys from seven to fifteen years of age, and the girls from seven to seventeen years of age. There are two or three excellent blocks of almshouses—one pile was founded by the late Mr. John Crossley, and another by Sir Francis Crossley, the total cost being over £50,000, including endowment. A much older charity is known as the Waterhouse Charity, established in 1636. There is a school, and there are almshouses, all modern buildings, in which accommodation is found for twelve poor widows. In recent years a number of houses were built by the trustees of the late Mr. John Abbott, as homes for ladies who had been reduced in circumstances. These homes are pleasantly situated, and are surrounded by extensive ornamental grounds.

In 1870 Sir F. Crossley made a gift of £10,000 towards establishing a loan fund to assist tradesmen of good character in the town. There is an excellent infirmary in the heart of the town. The literary institutions of Halifax are, the Literary and Philosophical Society, which has an elegant hall and a museum, and in connection with which a library and a lecture theatre were opened in 1872; the Mechanics' Institution, School of Art, and a Public Library, of recent formation. The town also contains two theatres.

In 1858 Sir F. Crossley presented the town with a People's Park, 12½ acres in extent, beautifully laid out by Sir Joseph Paxton; and in 1868 the same liberal donor made over the sum of 6000 guineas to be invested for its maintenance in proper order. A fine statue of him was subscribed for by the inhabitants, and erected in the park in 1860. Another park (Shroggs) was opened in 1881, and a third (Savile Park) is a large open space for recreation.

The chief articles manufactured at Halifax are worsted stuffs, including cashmeres, damasks, lastings, camlets, shalloons, says, serges, pelliones, merinos, moreens, italians, orleans, tammies, &c. High-class knitting wools and certain branches of the hosiery trade constitute a branch unequalled probably in any town in England. Machine and tool making are important industries, and card-making, as well as the manufacture of card-making machinery, are carried on to a considerable extent. There is a large trade done in wool, and of late the manufacture of worsted coatings has largely developed. Bombazines, crapes, and other fabrics composed of silk and worsted are also manufactured here, and the cotton trade is carried on to a great extent. There are extensive damask manufactories, and the carpet works of Crossley & Sons are the largest in the world. The silk and boot trades have of late developed considerably. Coal and stone abound in the neighbourhood.

Some of the refugee Flemings settled in the parish of Halifax in the reign of Henry VII., and stimulated the woollen manufactures of the district, if they did not originate them. Down to a recent period the dialect of the working classes strikingly resembled that of operatives in the Low Countries, especially in Friesland.

There formerly existed a very peculiar local law, by which every felon taken within the liberty with stolen goods to the value of 1*s.* 1½*d.* could, after three market days, be taken to the Halifax gibbet, and be decapitated. The instrument used was somewhat similar to the guillotine. The law was enacted as a protection to the manufacturers against the thievish propensities of their workpeople, who were in the habit of robbing their employers by keeping to themselves a portion of the material which ought to have gone into the cloth, so that when the latter was manufactured it was found to be of inferior weight and body.

HAL'IFAX, the capital of Nova Scotia, in the Dominion of Canada, is built on the declivity of a hill, the summit of which is 240 feet above the sea. It faces the harbour, which is safe and accessible at all seasons, and is defended by strong forts and batteries. The town is regularly laid out, and the streets are for the most part paved or macadamized. The buildings are now generally substantial brick and stone edifices. The local affairs are regulated by a mayor and eighteen aldermen. Among the public edifices are the residences of the governor and other authorities; the barracks and military hospitals, ordnance and commissariat departments; Dalhousie and other colleges, numerous churches, exchange, assembly rooms, and theatre. The Province Building, in the centre of the town, which contains the government offices and library, is a handsome well-built edifice of freestone, 140 feet long, 70 feet wide, and 42 feet high. The court-house, in which the Courts of Common Pleas and the sessions of the peace are held, is a plain brick building. Its pure air and beautiful surrounding scenery have brought Halifax into high repute as a watering-place. It is also the principal rendezvous of the British navy on the North American station, and it contains a well-appointed arsenal. It is also an important military post, there being usually two regiments stationed here. The harbour is part of an inlet which expands above the city into Bedford Basin, with an area of 10 square miles. This harbour is indeed unsurpassed in the world—being capacious enough to afford anchorage to all the navies of Europe. The British government have an extensive dockyard, covering 14 acres. The port communicates by a canal with the Bay of Fundy. The shortest sea route to England (Spithead) is 2510 miles. The town of Halifax is connected by railway with Montreal and New York, and has manufactures of paper, leather, and soap; foundries, distilleries, breweries, &c. Its exports of dried fish, timber, cattle, and whale and seal oil are very considerable. It is the seat of government for the province and of a bishopric, and carries on a large trade with the United Kingdom, the West Indian colonies, and the United States. The population of Halifax city, in 1881, was 34,102. Halifax was founded in 1749 by the Hon. Edward Cornwallis, who named it in honour of the Earl of Halifax.

HAL'IFAX, EARL OF (CHARLES MONTAGUE), poet and statesman, fourth son of George Montague, grandson of Henry first earl of Manchester, was born at Horton in Northamptonshire, 16th April, 1661. He was educated at Westminster School and Trinity College, Cambridge, and at the latter place he with a few other students assisted Newton in forming the Philosophical Society. A poem on the death of Charles II. gained him the patronage of the Earl of Dorset, through whose influence he entered Parliament as member for Malden in 1688. He voted for the declaration that James II. had abdicated, and retained his seat in the first Parliament of William III., whose favour he gained by a poem on the battle of the Boyne, and who bestowed upon him a pension of £500. In 1692 he was appointed a commissioner of the Treasury, and the same year he submitted to the House of Commons a proposition to raise £1,000,000 by way of loan, and thus laid the foundation of the national debt. In 1694, when money was again wanted, he supported the proposal of William Paterson for the formation of a national bank, and thus laid the foundation of the Bank of England. He was appointed chancellor of the exchequer on the 1st of November, 1695, to which, on the 1st of May, 1697, he conjoined that of first lord of the Treasury. In 1695 and 1696 he obtained great credit by his management of the operation of the general recoinage of the silver money. It was in the latter of these years that, to supply a temporary circulating medium, he contrived what are called exchequer bills, the convenience of which species of paper, both for the government and the public, has kept it in use ever since. On the modification of the ministry in November, 1699, Montague was removed to the auditorship of the exchequer. In the end of the following year he was created Baron Halifax (with remainder, failing his own issue male, to George Montague, son and heir of his eldest brother, Edward Montague). Lord Halifax was impeached by the new House of Commons, in April, 1701, and again in 1703, after the accession of Queen Anne, but on both occasions was protected by the House of Lords. Halifax first moved for the establishment of a public library, out of which eventually came the British Museum. On the 14th of October, 1714, he was raised to the dignities of Earl of Halifax and Viscount Sunbury, and was restored at the same time to his former post of first lord of the Treasury, his office of auditor of the exchequer being given to his nephew. He died of an inflammation of the lungs on the 19th of May, 1715. He possessed great financial and administrative ability, but is charged, and not unjustly, with arrogance and extreme vanity.

HALIO'TIS. See EAR-SHELL.

HALL MARK. The hall mark, so called because it is impressed at the Goldsmiths' Hall, is the stamp guaranteeing the degree of fineness of gold or silver. It consists of punch-marks struck upon some conspicuous part of the article, containing respectively the initials of the maker, the head of the reigning sovereign, the lion passant, the leopard's head, and a letter to denote the year in which the plate was assayed and marked. The last is a relic of a clumsy and truly mediæval mode of declaring the date. Twenty letters, from A to U (J being excluded), complete a cycle of as many years; which ended, the same letters, but of a different type, commence a fresh cycle. By referring to the list of these letters—obtainable at the hall—the date of any piece of plate can be ascertained as far back as 1696. But the custom dates from the year 1336, and in his work on the subject Mr. Chaffers, F.S.A., has completed the list of assay letters, by comparison with actual examples, as far back as the beginning of Elizabeth's series in 1558–59.

In London the assay year commences on the 30th May, and the date marks are continued regularly with twenty letters of the alphabet, using in succession Roman capitals, Roman smalls, and old English capitals. The series of London date marks, commencing 30th May, 1816, is as follows:—

a to u	from 30th May,	1816,	to 29th May,	1836.
𝔄 to 𝔘	"	1836,	"	1856.
A to U	"	1856,	"	1876.
$\boxed{A}$ to $\boxed{U}$	"	1876,	"	1896.

The assay of gold and silver in England originated with the Bishop of Salisbury, who was treasurer to Henry I. The first Act, however, that regulated the standard was in the reign of Henry III., in 1238; and the privilege of assay was granted to the Goldsmiths' Company by Edward I. in the year 1300. The leopard's head, with which all are so familiar in the English hall marks, was introduced by this charter. It is the device of the Goldsmiths' Company. In 1336 the mark of the actual manufacturer was intro-

duced, and also the assayer's mark, or variable letter, showing the year of the assay, previously alluded to. The lion passant, or "Her Majesty's Lion," is first mentioned in the company's records in 1597, but was not referred to in any statute till 1675.

Until the year 1798 no gold was allowed to be hall-marked if of a lower standard than twenty-two carats, *i.e.* twenty-two parts of pure gold to two of alloy; then that of eighteen (or one quarter alloy) was permitted, as being a quality best adapted for watch-cases, chains, and jewelry designed for hard wear; while subsequently it was allowed to hall-mark gold of fifteen, of twelve, and even as base as nine carats. Gold is impressed with all the above-named marks, excepting the lion passant, which is omitted, and in lieu thereof (on the superior standards) a crown and the figures 22 or 18 are stamped, to denote the quality. On the lower standards, no crown, but merely the figures 15, 12, or 9, and a corresponding decimal number, to indicate the quality.

The standard for silver in England (both coin and plate) from the Norman times till recently was very high, only 18 dwts. of alloy being allowed to the pound troy, or less than one-twelfth. Under William III. this standard was for a few years raised from 11 oz. 2 dwts. to 11 oz. 10 dwts. of fine silver in the pound troy, for plate alone.

Although the larger part of English plate is stamped in London, some other towns, such as Exeter, Birmingham, Chester, Sheffield, and Newcastle, have like privileges. There are also assay offices at Dublin, Edinburgh, and Glasgow. Exeter commenced in 1701 with a cycle of twenty-four letters, and the distinguishing mark of a castle. The Birmingham cycles, containing the full twenty-six letters of the alphabet, began in 1773, with the distinguishing mark of an anchor; for Chester, the city arms, viz. three garbs; for Sheffield, a crown; and for Newcastle, the town arms, viz. three towers. Scotch plate may have an earlier date. The first cycle of the Edinburgh assay office commenced under Charles II. in 1681. The distinguishing standard stamp of this office is a thistle, while Glasgow has a lion rampant. The hall mark of Edinburgh is a castle; that of Glasgow, the inartistic combination of a tree, a fish, and a bell. The Dublin assay-letters, twenty-five in number, began in the year 1646. The distinguishing stamp is a harp crowned.

The steady decline of late years in the manufacture of gold and silver plate has been attributed by many authorities to the embarrassing restrictions entailed by hall marks, together with the duties also levied on the articles manufactured. Much of this decline, however, is doubtless due to the development of electro-plate manufacture, which became fully established about 1846, from which date there occurred a marked diminution in the yield of the plate duties. Still there is no doubt that the artistic manufacture of silver and gold would be greatly stimulated were the trade perfectly free from all restriction, and probably the operation of this freedom as it exists in America was the means by which the New York firm of Tiffany obtained, at the Paris Exhibition of 1878, the first prize for excellence of silver manufactures. It is claimed that the indisputable guarantee afforded by hall marks is a protection to the public; but, on the other hand, there is a powerful incentive to fraudulent imitation of these marks, and frauds on a large scale easily pass undetected, especially as few purchasers understand the hall marks, which are arranged on a system useful enough as regards the trade, but utterly preposterous as regards the public. Moreover, there is some force in the argument that it is no more reasonable for the state to give a guarantee of the quality of gold and silver than to guarantee the genuineness of old pictures, jewelry, or the quality of wines and spirits. Indeed, as the revenue officers know more of the antecedents and treatment of the latter goods than anyone else, it would be even more reasonable to label spirits as "bottled in bond under the supervision of the revenue officers" than for government to carry on an assaying business, which could be done just as well by any private firm. The use of the labels referred to, however, is invariably disallowed, on the very ground that, though the fact of the supervision is true, the words used would imply a government guarantee of quality. It is a fair inference that the silversmith's and goldsmith's art enjoys a protection afforded to no other industry.

In 1879 the question was deemed sufficiently important for the appointment by the House of Commons of a select committee to investigate it, when it was found that the whole of the silversmith and pawnbroking trades clung with peculiar tenacity to the hall-marking system; while, it was alleged, the public made no complaint. The latter feature was perhaps natural, inasmuch as those chiefly interested were the possessors of gold or silver plate, the supposed value of which might be depreciated if other silver goods could pretend to the same quality and value without the necessity and expense of being hall-marked. The committee recommended the retention of compulsory hall-marking, but the abolition of the plate-duty; also the discontinuance of the lower standards of 9, 12, and 15 carat marks, and the placing of the assay offices under the Mint, instead of under the Goldsmiths' Hall.

As to foreign hall marks, no works have as yet been published on the subject. The great continental centres of works in the precious metals during the sixteenth and the seventeenth centuries were Augsburg and Nürnberg. The first city used the stamp of a pine-apple, and Nürnberg that of a capital N; but no date-stamps seem to have been employed. The goldsmiths of Amsterdam, on the other hand, seem to have used date-letters in conjunction with the town mark (a shield containing three crosses in saltire) and the maker's mark. The marks of the French goldsmiths are more systematic, but they have not been fully investigated. A formidable list of nearly 200 French communities of goldsmiths existing previously to 1786, and each using a proper emblem, has been compiled by MM. Lacroix and Seré in their "L'Histoire de l'Orfévrerie." The first ordinance that compelled the French goldsmiths to stamp their works seems to have been one of Philip the Bold in 1275.

The best works of reference on hall marks are "Hall Marks on Gold and Silver Plate, with Tables of annual Date-Letters," by William Chaffers; "Precious Stones and Precious Metals," by C. W. King; "Assay Marks" in No. 84 of the *Archæological Journal;* and Report of the Select Committee on Hall Marking, No. 191 Blue Book of 1879.

HALL, ROBERT, a celebrated Baptist minister and one of the greatest of English pulpit orators, was born 2nd May, 1764, at Arnsby, in Leicestershire. He lost his mother in 1776, and it appears to have been after this that he was sent to board at a Baptist school in Northampton, kept by the Rev. Dr. John Ryland, from which he went to the Bristol Academy, with the intention of becoming a Baptist clergyman. In the autumn of 1781 he was selected by the authorities of the Bristol Academy to be sent to King's College, Aberdeen, where after the usual four years' curriculum, he graduated in 1785. He had already, during the preceding summer, officiated as one of the regular pastors of the Baptist congregation at Broadmead, Bristol, in association with Dr. Caleb Evans; and in August, 1785, he was also appointed classical tutor in the Bristol Academy. His father died in 1791, and the same year a difference with Dr. Evans led to his removing from Bristol, and accepting an invitation to become pastor of the Baptist congregation at Cambridge.

He had already acquired considerable celebrity as a preacher, but it was not till now that he appeared as an

author. His first publication (unless we are to reckon some anonymous contributions to a Bristol newspaper in 1786–87) was a pamphlet entitled "Christianity consistent with a Love of Freedom, being an Answer to a Sermon by the Rev. John Clayton" (8vo., 1791). In 1793 he published another liberal pamphlet, entitled "An Apology for the Freedom of the Press, and for general Liberty, with Remarks on Bishop Horsley's Sermon preached 31st January, 1793." The impression that had been made upon him, however, by the irreligious character of the French revolutionary movement was indicated in his next publication, "Modern Infidelity considered with respect to its Influence on Society, a Sermon" (8vo., 1800). It was the publication of this able and eloquent sermon which first brought Hall into general notice.

In November, 1804, Hall was visited by an attack of insanity, from which he did not entirely recover for some years. His state of health made it necessary for him to resign his charge at Cambridge; but, apparently about 1807, he became minister of the Baptist chapel in Harvey Lane, Leicester, and this situation he held for nearly twenty years. He married in March, 1808. At last, in 1826, he removed to the pastoral care of his old congregation at Broadmead, Bristol; and here he remained till his death, which took place at Bristol, 21st February, 1831.

Besides occasional contributions to various dissenting periodical publications, Hall published various tracts and sermons in the last twenty years of his life, which, along with those already mentioned, were collected and reprinted after his death, in six vols. 8vo. (London, 1831–32).

HAL'LAM, HENRY, an eminent historian and critic, was born in 1777 at Windsor, and educated at Eton and Christ Church, Oxford. He studied the law for some time, and became a bencher of the Inner Temple. His political creed was that of liberalism, but he never actively engaged in politics; co-operating, however, and that heartily, in the movement for the abolition of the slave-trade. He was one of the earliest contributors to the *Edinburgh Review*. In 1818 was published his first elaborate work, the "View of Europe during the Middle Ages." In 1827, the "Constitutional History of England, from the Accession of Henry VII. to the Death of George II." was published. This work has become a standard authority, and is a text-book at the universities. In 1838 appeared the "Introduction to the Literature of the Fifteenth, Sixteenth, and Seventeenth Centuries," which is unrivalled for the justness of its criticism and the variety of its learning. All these works have passed through numerous editions, and been translated into the languages of the leading European nations. Mr. Hallam was a fellow of the Royal Society, a member of the Society of Antiquaries, and a trustee of the British Museum. He married a daughter of Sir Abraham Elton; and of a numerous family only two sons and two daughters survived the period of adolescence. Both the sons and one daughter were prematurely cut off; the elder, Arthur Henry, who died in 1833, was the intimate friend of Tennyson, the poet-laureate, and is the subject of "In Memoriam." Mrs. Hallam, her eldest daughter, and remaining son died soon after. Bowed but not broken by these sorrows, Mr. Hallam preserved his vigorous faculties to the last, and closed his long and honoured life in calm Christian peace, on the 22nd of January, 1859.

HAL'LE, a town in the district of Merseburg and province of Prussian Saxony, stands on the Saale, 53 miles S. by E. from Magdeburg, and 19½ N.W. from Leipzig, by the railway that unites these two cities. The population of the town in 1882 was 71,484. It is celebrated chiefly for its salt-springs and salt-works, and as the seat of a university. It consists of three towns—Halle itself with five suburbs, and Glauchau and Neumarkt, which have magistrates of their own. The university was founded in 1694, and united in 1815 with that of Wittenberg. It possesses a valuable library, museum, anatomical theatre, chemical laboratory, botanic garden, and an observatory. Outside the walls is a monument to the Germans who fell in the battle of Leipzig. Halle was formerly strongly fortified, but the site of the fortifications is now converted into promenades, and the town has been much modernized and improved. The university buildings, the churches of St. Mary, St. Ulrich, and St. Maurice, the cathedral, the Red Tower in the market-place, and the town-hall are the most remarkable structures. The ancient Castle of Moritzburg was reduced to a ruinous condition in the Thirty Years' War, and only a wing now remains. Halle possesses many educational and charitable institutions, foremost among which is the Francke Institution, embracing an orphan house and schools. The town is distinguished by the activity of its printing-presses, and is also an important railway centre. Its name is derived from *Hall*, an old word for salt, in consequence of the numerous brine springs of the place and neighbourhood, from which a large quantity (from 200,000 to 300,000 cwts.) of salt is made annually, by a peculiar class of workmen called the "Hallores." The town was the birthplace of Handel (to whom a bronze statue was erected in the market-place in 1859), and Michaelis and many eminent names are associated with its university.

HALLELU'JAH (properly *Hallelu-yah*, *Halleluia*, or *Alleluia*), a Hebrew compound word, which means "praise ye Yah" (Jehovah), was used by the Jews in songs of praise and in solemn thanksgivings to God. It was retained in the Greek and Latin liturgies in the original Hebrew; but in the prayer-book of the Church of England its English equivalent, "Praise ye the Lord," is used.

HALLER, ALBERT VON, an eminent anatomist and physiologist, was born at Berne, 16th October, 1708, of an ancient and respectable family. His father, Nicholas Emmanuel von Haller, was an advocate. In his early life Haller was feeble and delicate. His father had intended him for the church, but, his own inclination leading him to the study of physic, he went in 1723 to the University of Tübingen. Being but little satisfied with his progress here, he resorted in 1725 to Leyden, where Boerhaave was then in the height of his fame, and Albinus was delivering the lectures on anatomy and surgery. At the end of 1726 he offered himself for his doctor's degree, and delivered his thesis "De Ductu Salivali Coschwiziano," which he showed to be merely a bloodvessel. In 1727 he visited London, where he became acquainted with Sir Hans Sloane and Cheselden; thence he went to Oxford, and next to Paris, whence, having pursued his anatomical and surgical studies for some time under Winslow and Le Dran, he went to Basel to study mathematics under Bernouilli, and then returned to his native country and began to practise as a physician. In 1735 he was appointed physician to the hospital at Berne, and soon after principal librarian to the large public collection of books and medals; but these offices he did not hold long, for in the following year he was offered the professorship of medicine, anatomy, botany, and surgery at Göttingen by George II., which after some hesitation he accepted. Having declined practising, he devoted himself to the duties of his office with the greatest zeal, and especially exerted himself to increase the facilities for the study of anatomy. During the eighteen years that he retained this appointment, while fully discharging all his laborious duties, he was a constant contributor to the different scientific transactions. In 1747 he published the first edition of his "Primæ Lineæ Physiologiæ," which he had that year used as the groundwork of his lectures, having previously employed the "Institutions" of Boerhaave. In 1751 the Royal Society of Göttingen was established, and Haller, at whose house the first meeting took place, was appointed perpetual president. To their *Transactions*, of which the first volume appeared shortly

after under the title of "Commentarii Societatis Regiæ Scientiarum Gottingensis," he was a constant contributor, even after 1753, when, in consequence of the delicate state of his health, being obliged to leave Göttingen, he retired to Berne. Here he resided during the rest of his life, constantly occupied in the publication of his most important and voluminous works, in the cultivation of the science of his profession and of general literature, and in the active and honourable discharge of the various duties in the service of the republic, in which he at all times strenuously advocated the cause of the aristocracy. He died in October, 1777, in the enjoyment of the highest reputation as a citizen, a scholar, and a philosopher, his literary labours ceasing only with his life.

Haller was fortunate in receiving the high honours which he deserved during his lifetime. In 1739 he was appointed physician to the King of England. In 1743 he was elected a fellow of the Royal Society of London, and at different times subsequently of all the scientific societies of Europe; and he enjoyed throughout his life the friendship and esteem of the most eminent of his contemporaries throughout Europe.

Some idea of the extent of the works of Haller may be formed from the fact that the titles of nearly 200 treatises published by him from 1727 to 1777 are given by Senebier in his "Eloge" of Haller, and that this list does not profess to be complete. He is unanimously regarded as the father of modern physiology, whose history commences with his writings. He was the first to investigate independently the laws of the animal economy, which had before been studied only in connection with the prevailing mechanical and chemical or metaphysical theories of the day. Commencing with a sound knowledge of anatomy and of the structure of the organs in the dead body, he sought experimentally and systematically to discover the laws which govern their actions during life, proceeding from the most simple to the most complex phenomena. His name is especially connected with the discoveries in connection with the phenomena of muscular irritability, the processes of generation, and the development of life in the fertilized egg.

HALLEY, EDMUND, a celebrated English astronomer, was born 29th October, 1656, at Haggerston, which was then one of the outlying suburbs of the metropolis. He was educated at St. Paul's School, under the care of Dr. Gale, and was placed at Queen's College, Oxford, in 1673, being then possessed of much erudition for his age, and a strong turn for observation, as appears by his having discovered for himself before he left school the alteration in the variation of the magnetic needle. At the university, being well supplied with instruments by his father, he began to apply himself to astronomy, and before he had reached the age of twenty he had given (in the *Phil. Trans.*) a memoir on the problem of Kepler, had invented a method of constructing the phases of a solar eclipse, and had made many observations, particularly of Jupiter and Saturn. Furnished with a recommendation from Charles II. to the East India Company, he set sail for St. Helena in November, 1676, and remained there two years, engaged in making observations of the southern hemisphere. His "Catalogus Stellarum Australium," published in 1679, was the result of this voyage, and contains, besides the positions of 350 stars, some other points of interest, particularly an observation of the transit of Mercury over the sun's disc, and a hint that such observations might be employed to determine the sun's parallax (recently so successfully carried into effect with the planet Venus). He also noticed the increased curvature of the moon's orbit when in quadratures, which was afterwards explained by Newton. In his voyage out he had observed the fact that the oscillations of a pendulum increase in duration as the instrument approaches the equator.

On his return from St. Helena the king granted him a mandamus to the University of Oxford for the degree of Master of Arts, and he was elected a fellow of the Royal Society. This society sent him to Dantzic in 1679 to judge of the observations of Hevelius, who maintained the superior accuracy of instruments with simple sights in opposition to Hook, who advocated the use of the telescope. Halley was a man of rapid movements; in November, 1678, he returned from St. Helena; in May, 1679, he set out for Dantzic, having in the interval published his catalogue and procured his Oxford degree and admission to the Royal Society. He returned from Dantzic in July, and remained at home till the end of 1680, at which time he set out on a continental tour, accompanied by his schoolfellow, Mr. Nelson, afterwards known as the author of a work on the feasts and fasts. In December, being on the road to Paris, he saw the celebrated comet of 1680 in its return from perihelion, being the first who perceived it since it was lost in the preceding month. This body he observed with Cassini at Paris, and the observations thus made are remarkable as forming part of the foundation upon which Newton, in the "Principia," verified his deduction of a comet's orbit from the theory of gravitation. He returned to England at the end of 1681, and in 1682 married the daughter of Mr. Tooke, auditor of the exchequer, with whom he lived fifty-five years. He resided at Islington till 1696, and in 1683 published his theory of the variation of the magnet, followed by other papers in subsequent years, containing ingenious speculations now forgotten. His astronomical occupations during this period consisted chiefly of lunar observations and comparisons.

Among other objects of speculation he had considered the law of attraction, which he imagined must be as the inverse square of the distance. Having applied in vain to Hook and Wren for assistance in the mathematical part of the problem, he heard of Newton, and paid him a visit at Cambridge. Finding all he wanted among the papers of his new friend, he never rested until he had persuaded Newton to publish the "Principia," of which he superintended the printing, and supplied the well-known copy of Latin verses which stands at the beginning.

In 1698 King William, who had heard of his magnetic theory, gave him the commission of captain in the navy, with the command of a small vessel, and instructions to observe the variation of the magnet and the longitude and latitude of places in the American settlements, and to attempt the discovery of land south of the western ocean. Setting out in the month of September in that year, he observed in many parts of the Atlantic as far as the ice would permit, touched at the Canaries, Madeira, Cape de Verd Islands, St. Helena, Brazil, Barbadoes, and returned, September, 1700, without having lost a man by sickness during the whole voyage. He published in 1701 a chart of the variation of the magnet in all seas of the known world, and immediately afterwards sailed to survey the coasts of the Channel, of which he also published a chart. He was then twice successively ordered to the coast of the Adriatic to assist in the formation and repairs of harbours in the Emperor of Germany's dominions, and returned to England in November, 1703, just in time to succeed Dr. Wallis, who had died a few weeks before, in the Savilian chair of geometry at Oxford.

At the beginning of 1720, after the death of Flamsteed, Halley was appointed astronomer-royal. He died on 14th January, 1742, in the eighty-sixth year of his age.

Among the Englishmen of his day Halley stands second only to Newton, and probably for many years after the publication of the "Principia" he was the only one who could and would rightly appreciate the character and coming utility of that memorable work.

In astronomy we owe to Halley—1, the discovery and the detection of the amount of what is called the *long*

inequality of Jupiter and Saturn, which he confidently expected would be shown to be a consequence of the law of gravitation, as was afterwards done; 2, the detection, by comparison of ancient and modern observations of eclipses, of the slow acceleration of the moon's mean motion; 3, the first prediction of the return of a comet; 4, the explanation of the appearance of Venus in the daytime at particular seasons, arising out of the now well-known method of estimating the brilliancy of the planet; and 5, the recommendation to observe the transit of Venus for the determination of the sun's parallax.

HALLEY'S COMET. See COMETS.

HALLOW-EV'EN or **HALLOWEEN'**, the night preceding Hallowmas or All Saints' Day, which falls on 1st November, so that Halloween is the night of the 31st October. In the middle ages it was customary in England to celebrate this evening by a series of fireside games, and similar practices were observed in Scotland, though in the latter place certain methods of divination were practised with a view of getting a glimpse of the future. The kindling of a fire seems to be the essential part of the observances of the evening, and hence the custom has been supposed to be a relic of the primitive heathen days when fire-worship, or the kindling of sacred fires, was widely spread throughout Europe. The best-known description of the Scottish observance of this festival is that which is given by Burns in his "Halloween." See also Brand's "Popular Antiquities."

HALLUCINA'TIONS are false perceptions of any organ of sense for which there is no external cause or origin. All the bodily senses are liable to such delusions, but the most frequently affected are those of sight and hearing. Medical authorities are not agreed as to the proportions in which the senses are affected, but some careful observations which extended to a large number of cases showed that for every hallucination of the sense of smell there were three of touch, eight of taste, forty-eight of sight, and forty-nine of hearing. Of the inmates of Bicêtre the investigations of Baudry, Thore, and Aubanel showed that in round numbers about one-third were affected with hallucinations. Persons suffering from the delirium of fever are frequently affected in this manner, and it is an almost invariable accompaniment of delirium tremens. In the latter disease the whole of the senses may be sources of hallucination; the taste finds poison in the food or medicine presented, disgusting smells are imagined, voices threatening or deriding are heard, and the visions of loathsome or terrifying objects may be of marvellous distinctness and intensity.

Occasionally persons who are suffering only from a low state of health become the victims of hallucination, and where the real cause is unperceived, such subjective sensations may give rise to considerable mental disturbance, or possibly to superstition. It is also an unquestionable fact of physiological science that persons who enjoy sound health may be tormented with hallucinations which they cannot dismiss by any effort of the will, although they are conscious of their subjective nature. One of the most remarkable instances of this kind is that which is described by Sir David Brewster in his "Natural Magic," in which a lady of great intelligence and unusual strength of mind, not only heard herself addressed by imaginary voices, and saw distinctly the figures of her friends, &c., when alone, but was also visited by spectral illusions when in the company of others, and on one occasion had a vision of a friend wrapped in grave-clothes and bearing the appearance of death, the said friend being at the time alive and in perfect health.

Among celebrated men who have been subject to hallucinations the cases of Luther and Swedenborg are perhaps the most striking. Luther appears to have been troubled chiefly by the apparition or the voice, as he supposed, of Satan, and his use of his inkstand as a missile against his enemy is well known. Of Swedenborg it is recorded that he saw members of the heavenly hierarchy seated among the members of the council board when he was at the head of the government; while the visions he records in the works composed during the latter half of his life are of the most extraordinary character. They are recorded, however, with so much simplicity and clearness that there can be no reasonable doubt of his own absolute conviction of their reality. Sir Walter Scott is said to have been subject to hallucinations; and the late Earl Grey was troubled by the peculiar spectral illusion of a gory head, which, however, he could banish temporarily by a strong effort of the will. It is probable that a large number of the ghost stories which are recorded as the personal experiences of persons whose sincerity cannot be doubted, are in reality the results of hallucination in the first instance, to which the imagination has unconsciously added details in subsequent narrations; but it must be admitted that there are some for which this explanation is inadequate.

HALO is a circular band of faintly coloured light which is occasionally seen surrounding the disc of the sun or moon at a distance from it equal to 22½, or less commonly to 47 degrees. The colours of the solar halo are such as are observed in the rainbow, but they are less bright, and do not always follow the same order as in the bow. Sometimes the red is next the sun and a pale blue on the outside; but at other times indigo and violet are without. Frequently, on the other hand, they are red or yellow in the inside, and white on the outside. One of the observations on halos mentions the colours as white in the middle, followed by red, blue, and green, its outermost border being a bright red. In another case a pale red on the outside was followed by red and green, terminating with white on the inside. The space of sky of which the circumference is the halo, is frequently of a most intense gray, of a deeper blue than the rest of the heavens, when the atmosphere is misty, or of a transparency more or less perfect. The lunar halo in general appears to be white, but it is at times tinted with pale green and red, or pale red alone. The white circle is sometimes well defined on the inner side, so as to make the included space appear dark, while on the other side it passes insensibly into the colour of the sky. Often about either luminary the halo is double, consisting of two concentric circular bands, the exterior one being broader than the other, and the two being separated by a broad clear space.

When a mist or a thin cloud is between the sun or moon and a spectator, there is frequently observed an ill-defined circle of coloured light immediately surrounding the disc of the luminary; this is called a *corona*. It sometimes appears when a halo is also seen, but it is more commonly observed without such accompaniment. It is produced by the refractions of light in the globules of water which are suspended in the atmosphere between the spectator and the luminary. The smaller the size of the globules the greater the diameter of the corona; when this contracts, therefore, it shows that the drops are large, that the moisture is condensing, in fact, and that rain will shortly fall. The colour of the corona is usually orange or red.

Images of the sun have been occasionally seen as if by reflection from some cloud, the sun being near the horizon; these are called *anthelia*. They are produced by the reflections of light in prisms of ice having their axes in vertical positions.

Halos are frequently accompanied by a horizontal ring or band of whitish light passing through the sun or moon, and in some recorded cases extending round the whole sky in a vast horizontal circle, of which the zenith-point was the centre; and at times a similar band appears in the direction of a diameter perpendicular to the horizon. At the intersections of these bands with the halo are sometimes seen images of the sun or moon, which are ill defined and less bright than the true disc of the celestial body; these, when the halo is formed about the sun, are called *parhelia*

and when about the moon, *paraselenæ*. Occasionally, also, segments of circles, or branches of curves of contrary flexure, proceed from these images of the sun or moon, so as to assume the appearance of wings or tails.

Many remarkable phenomena of this kind have at various times been observed. In the "History of England" by Matthew Paris there is a description of a halo with four false suns, which is stated to have been seen in the year 1233 on the borders of Herefordshire and Worcestershire. In 1586 Rothman observed at Cassel, soon after sunrise, a false sun above and one below the true sun, all being in one vertical line; and in 1661 Hevelius at Dantzic observed a double halo accompanied by four false suns and by several segmental bands of light, three of which had false suns at their places of intersection (see Plate, fig. 19). In the last-mentioned year Hevelius also observed a halo with two paraselenæ and a double corona encircling the body of the moon; and a very remarkable halo was seen by Sir Henry Englefield at Richmond in 1802 (*Journal of the Royal Institution*, vol. ii.) Besides these many such phenomena have been observed in Europe, in the United States, and in Canada; and Captain Parry observed and measured several during his voyages to the Arctic regions. One of these was the great double halo with a horizontal circle of light (see fig. 17 on Plate).

In the tropical regions coloured halos are frequent and brilliant; and near the equator Humboldt observed small ones surrounding the planet Venus.

The explanation which has been given of the halo by Mariotte and Dr. Young is nearly as follows:—Between the spectator and the sun innumerable crystals of snow or ice, having nearly the form of equilateral prisms, may exist in the air in all possible positions; of these vast numbers many have their transverse sections in planes nearly passing through the sun and spectator; and it will follow, after two refractions at the edges, that the deviation of the refracted from the incident ray, at the eye of the observer, is about equal to the semidiameter of the halo. This taking place in all planes so passing, a circle of refracted light is seen. Cavendish suggests that the exterior halo may be produced by the two refractions which a ray would undergo in passing through a face and one end of a prism, that is, through two surfaces which are at right angles to one another.

Plates of ice disposed so as to reflect the sun's light in a vertical plane may be the cause of the column which is sometimes seen to form a vertical diameter of a halo; and the blending of the reflected rays with the rays refracted from the sides of the prisms, at the places where the horizontal and vertical bands of light intersect the halo, is apparently the cause of the parhelia which are very generally observed in those parts of the halo. When the transverse sections of the refracting prisms deviate from a plane passing through the observer towards the right or left, the axes being horizontal, there will be produced a curvilinear band of light, like a wing, inclining upwards on either side of a parhelion. The *cirro-stratus* is the kind of cloud which gives halos, and it usually floats over 20,000 feet high, where moisture would surely take the form of ice from the great cold. Halos are far more frequent in winter than in summer. They nearly always foreshadow a storm; for the presence of large bodies of moisture which they indicate is usually due to barometric pressure not far distant, and as the latter approaches it of course brings with it a storm.

A beautiful optical instrument, called a *haloscope*, has been invented in France for the exhibition of all the phenomena connected with halos, such as the corona, anthelia, parhelia, &c. It consists of prisms, sheets of plate-glass, and mirrors, mounted on an axis, and having a rotatory motion, and differently arranged to show the various circles.

A variety of halotic forms is shown in the Plate. Fig. 1 is a *corona;* 2 is a true halo; 3, a double halo; 4, an imperfect double halo; 5, a lunar halo with corona; 6 and 7 show false images of the sun or *parhelia*, s being the true sun, s^1 the *parhelion.* Fig. 8 shows a pair of parhelia. Parry, the Arctic voyager, records a case of two parhelia (fig. 9), s^2 being much fainter than s^1, and each being furnished with strips of prismatic colours extending to the horizon. In another modification (Parry) three parhelia are connected by a bright circle (fig. 10); and in the similar case of fig. 11 the parhelia were almost too bright for the naked eye. Fig. 12 is a magnificent assemblage of rays and parhelia seen by Parry. Fig. 13 was seen at Bedford by White. A B is the western horizon, and s a portion of the solar disc, appearing like burnished gold above a dark cirro-stratus cloud; s^1, s^2, s^3, were three parhelia; and *d e* was a column of white light; *f*, *g*, *h*, fragments of a solar halo coloured prismatically; *i*, *k*, *l*, three trains of light, whereof *k* was yellow; *m* terminated abruptly, but *n* in a distinct point. Parhelia are sometimes found, but very rarely, outside a halo, as in fig. 14, where a secondary inverted halo is seen beginning above. This curious secondary formation is shown in a more complex example at fig. 15, and still more at fig. 16, the latter observed by Mr. Folkes, president of the Royal Society. The curious fig. 17 was observed by Parry in the Arctic regions. Here *q r* is the horizon; *t u*, a horizontal circle of light; *k l*, a portion of an inverted halo cut across by an elliptical curve, *k e l*, and inclosing a space dazzlingly brilliant. s represents the place of the true sun, having an altitude of about 23°, in the circle of light, *t u*, extending completely round the sky at that altitude. Surrounding all was a prismatic circular halo, strongly coloured at *q*, *f*, and *r*, less so at *y* and *y*, above which was a prismatic inverted arch, *m f n*. Springing from the points *q* and *r* were arcs, *q o* and *r p*, of large circles. In fig. 18 a most unusual distribution of the parhelia is observed, and each parhelion has its own halo, as in s and s^1, that in s^1 being almost as bright as that of the sun itself, while the force of the junction of the three false halos at *n* is so great as absolutely to show a large part of a fifth halo at *q r*. Fig. 19 is that alluded to above as having been seen by Hevelius at Dantzic in 1661. Parhelia generally occur best with a low sun. They appear in Arctic regions soon after sunrise, and last all the day. Many parhelia are sometimes seen at once. In 1829, at Kaihta in Siberia, luminous rays were seen extending from the sun, an appearance not uncommon there, and named "the sun's ears." But on this occasion the "ears" extended like comets' tails, and eventually surrounded the heavens with a circle of light in which seven brilliant mock suns floated. Fallows at the Cape of Good Hope saw seven mock half-suns, when the sun was setting and was half below the horizon of the sea.

Not only are there parhelia or mock suns, but the moon also has her *paraselenæ* or mock moons. Parry records many fine appearances of this sort. In one case the moon had a halo whose radius was 22° 30′, and which contained three paraselenæ very bright, but not prismatic. A vertical stripe of white light proceeding up and down from the true moon formed a cross with a horizontal band of light passing through the moon, and extending for many degrees on each side of her, and the paraselenæ occurred at the points of intersection of the cross with the halo (compare fig. 11).

HALORA'GEÆ, a small order of plants, many of which inhabit watery places, and all of which have minute inconspicuous flowers. They belong to the cohort Rosales among the POLYPETALÆ. [See BOTANY.] This order includes the British genera Hippuris ("mare's-tail"), Myriophyllum, and Callitriche, plants found in damp places and ditches. There are eighty species, distributed among nine genera; they are found all over the world. The flowers are very often incomplete, the parts of the flowers arranged

in twos or fours. The calyx is adnate to the tube of the ovary. The petals are sometimes wanting; stamens two to eight; ovary inferior, one to four celled, with one to four distinct styles; ovules solitary and pendulous in the cells; albumen fleshy. The type of the order is the genus Haloragis, in which there are four petals and eight stamens; the species are natives of Eastern Asia, Australia, New Zealand, and the islands of the Pacific. *Haloragis citriodora*, found in New Zealand, derives its specific name from its fragrant odour. *Gunnera scabra* is cultivated for the beauty of its leaves, which are sometimes more than 6 feet in diameter; its roots are used in Chili for tanning, and as a remedy in dysentery. The fruit of *Gunnera macrophylla* is used in Java as a stimulant.

HALS, FRANS, an eminent Dutch portrait painter, born at Mechlin, 1584; died in 1666. He devoted himself almost exclusively to portrait-painting, and in that department no artist of his time was superior to him except Vandyck, and very few could be compared with him. His brother, Dirk Hals (1589–1657), was an excellent animal painter. There is a fine "Convivial Party" by Dirk Hals in the National Gallery. Several of Frans Hals' sons were artists, but none of any great fame.

HAL'YARDS, the smaller ropes and tackle used in hoisting sails or other portions of a ship's equipment. *Signal halyards* are those which carry flags to the masthead.

HAM, properly the inner or hind part of the knee, but more commonly the name given to the thigh of an animal prepared for food by salting, drying, and smoking. The flesh of swine is most frequently cured in this way, and when the term is used alone it generally signifies this, other kinds of ham being distinguished as mutton-ham, beef-ham, &c. The curing of pork hams is carried out by a variety of methods, and many districts are celebrated for their peculiar modes of curing, but the essential part is the same in all cases, and consists in impregnating the meat with sugar, salt, saltpetre, &c., and afterwards drying and smoking it. A common method of doing this is as follows:—Let the fresh meat in the first instance be well rubbed with coarse sugar, and then allowed to lie for twelve hours; then it is to be rubbed with a mixture of common salt and pounded saltpetre, a pound of the former to an ounce of the latter; and let it lie three weeks in the brine of this mixture, turning it every day. It may then be either hung up to dry in a cool place, or be smoked by hanging it over a fire of non-resinous wood or of peats. In old-fashioned country houses where wood is used for fuel, the hams are often hung inside the chimneys; but little erections, known as smoke-houses, are more commonly used for this purpose. These are built in three storeys or chambers, the fire being kindled in the lowest, and the meat hung in the two upper chambers. The fuel used generally consists of oak or beech chips and sawdust, and the fire is kept smouldering for five or six weeks. The celebrated Westphalian hams are hung in a smoke made by burning juniper-wood.

HAM, a town and fortress of France, in the department of Somme, about 40 miles south-east of Amiens. In the Castle of Ham, which was founded in the twelfth century, but largely extended and strengthened in the fifteenth century, Louis Napoleon (afterwards Napoleon III.) was confined for nearly six years (from 1840–46), at last effecting his escape in the disguise of a workman. The population of the town is about 3000.

HAM, the second of the three sons of Noah. The name is derived from the Hebrew *hamam*, to be hot, and many scholars identify this word with the old Coptic or native name of Egypt, *Keme* or *Khemi*, which signifies black. Ham is spoken of in the book of Genesis as being the ancestor of all the southern nations of the earth, his sons being Cush, Mizraim, Phut, and Canaan. Of these the settlements of Cush seem to extend from Babylonia along the shores of the Indian Ocean to Ethiopia, those of Mizraim to be in Egypt, Phut in North Africa, and Canaan in Syria. In the Psalms there are three references to Egypt as the land of Ham.

HAM'ADRYADS (Gr. *hama*, together; and *drus*, an oak), a name of the Greek and Roman poets for certain woodland deities who were presumed to be the divinities presiding over woods and forests, or even over particular trees with which they were co-existent. See also NYMPHS.

HAMAMELID'EÆ is a small order of plants nearly allied to HALORAGEÆ, and like it belonging to the cohort Rosales among the POLYPETALÆ. The flowers are sometimes unisexual, the male flowers often without a perianth. The stamens are four or numerous. The ovary is sometimes only partially inferior, with two cells, which are free at the apex. The ovules are solitary and pendulous, or indefinite and affixed to the axis. The species are trees or shrubs, with leaves generally alternate and stipulate, and flowers generally in heads. There are thirty species in fifteen genera, natives of the warmer parts of Asia, South Africa, and North America. The leaves and bark of *Hamamelis virginica* are astringent, and contain a peculiar acrid essential oil; the oily kernels are eaten. The wood of Parrotia is called *iron-wood* in Persia, on account of its hardness. The North American liquidamber balsam is produced by *Liquidamber styraciflua*; it contains benzoic acid, and is of the consistence of a thick oil. *Liquidamber Altingia* yields liquid styrax, used in the East as a perfume and an ingredient in various medicaments; it forms vast forests in Java and other parts of Asia.

HAM'BURG, a large city in Germany, the most important centre of commerce in that country, is situated in 53° 32′ N. lat., and 9° 58′ E. lon., 184 miles by railway north-west from Berlin, and about 70 miles from the mouth of the Elbe. Its origin is attributed to Charlemagne. The founder chose for its site the most elevated spot on the north bank of the Elbe and the east bank of the Alster, about 75 miles from the German Ocean. It was several times destroyed by the neighbouring barbarians, yet it always recovered, and had attained considerable commercial importance at the beginning of the twelfth century. In the thirteenth century it concurred in the formation of the Hanseatic League. By degrees it extended widely on both sides of the Alster. Its rights as an estate of the empire were long contested by the Danish kings, and it was not until 1618 that they were recognized. It did not, however, obtain a seat or vote in the Diet of the German Empire till 1770. From 1802 till 1815 Hamburg was scarcely free for a year from French domination and exaction, and it suffered most severely. In 1815 it joined the late German Confederation as a free Hanseatic city. For all its severe sufferings, including the robbery of the bank, a very inadequate indemnity was obtained from France at the peace; but the public spirit of the inhabitants, its internal resources, and its favourable situation soon restored it to more than its former prosperity.

Hamburg, in conjunction with the other Hanse towns, joined the North German Confederation in 1867. and the German Empire in 1871, but did so rather from necessity than from any wish of its own, as it involved to a great extent the surrender of its independence. The new state of things has, however, rather improved its foreign trade than otherwise. The territory of Hamburg, including the area of the city, is about 148 square miles, bounded on the south by the Elbe, and on the other sides by the Danish territories. In 1881 the population had increased to 453,869, of whom 410,127 resided in the city of Hamburg and its immediate suburbs. The population of the territory in 1861 was 229,941.

Hamburg is divided into the old and new town. After the great fire in 1842, when fully one-fourth of the city

was destroyed, including most of its public buildings, it became greatly altered in appearance; and the new part of the present city is remarkable for its fine, open, well-lighted, and well-drained streets, and its spacious and lofty houses. The arm of the Elbe next the town is narrow, but the two harbours are capable of receiving a considerable number of ships. The old town is so intersected with canals as to resemble a Dutch city; the canals are filled chiefly by the Elbe, but partly by the Alster, and almost all the warehouses are close to them. The Alster forms on the north side of the town a fine basin, on the sides of which are the finest houses in the city, with spacious walks planted with trees. The old ramparts are beautifully laid out as a public garden and promenade all round the city. North of this Inner Alster is the Outer Alster, a very large basin, on the banks of which are numerous fine country seats. A place of worship most worthy of notice is the spacious Church of St. Michael, begun in 1751 and completed in 1762, except the spire, which was not erected till 1778. This church was built by Sonnin, and is capable of accommodating 6000 persons; the height of the steeple is 426 feet. The most important of the churches is that of St. Nicholas, erected after the fire of 1842 by Sir G. Gilbert Scott in the rich Gothic style of the thirteenth century. It has a tower 473 feet in height, the third highest in Europe. In the rich sculpture of the exterior and interior it is intended to perpetuate the memory of everyone who has in any way tended towards the propagation of Christianity. The exchange—the most commodious in Europe—the bank, the observatory, and the theatres are among the chief public buildings. The charitable and scholastic institutions are numerous, and on a most liberal scale. The former include an infirmary, an hospital for the support of 142 aged persons, and a large school for the training and education of depraved and neglected children. There are two educational institutions supported by the state, designed to qualify young men for the university, and a gymnasium. There is also a fine botanical garden. The gallery of art is an exceedingly handsome building. Opposite it is a fine statue of Schiller. Hamburg has been the birthplace of many learned men, and the chosen residence of many others. Its numerous literary institutions, its private collections of paintings, the general taste for music, the fondness for the study of foreign languages, prove that the whole attention of the inhabitants is not absorbed by thirst of gain. The city library contains nearly 200,000 volumes, besides 5000 volumes of MSS.

Hamburg is essentially a commercial city, its port being the main channel of communication between North Germany and foreign countries. The navigable channel of the Elbe has been so much improved that vessels drawing 18 feet can now, under favourable circumstances, come up to the city at high water, and steamers can discharge their cargoes alongside quays furnished with steam cranes, commodious sheds, and warehouses, and having direct railway communication with all parts of Germany. The river may also be navigated by lighters for a long distance into the interior, and advantage has been taken of natural facilities to extend the internal navigation still further. A water communication has been established, by means of the Spree and of artificial cuts and sluices, between the Elbe and the Oder, and between the latter and the Vistula; so that a considerable part of the produce of Silesia destined for foreign markets, and some even of that of Poland, are conveyed to Hamburg. There is also canal communication with the Trave, and thus with Lübeck and the Baltic. But the great lines of railway which now unite Hamburg with all parts of the interior of Germany have vastly extended her connections, and are now even of more importance than her command of river and canal navigation. Hamburg ranks as the greatest emporium of trade on the Continent, and next to London has the largest money-exchange transactions in Europe. Its commerce includes every article which Germany sends to or receives from foreign countries.

The number of vessels which annually enter and clear at Hamburg is about 6000 (of 3,000,000 tons), of which nearly one-half were British. The harbour presents a picturesque and busy scene. The quays stretch along the bank of the river for a distance of over 3 miles, and accommodate upwards of 400 sea-going vessels and as many barges and river craft. The value of the imports is over £100,000,000 per annum, of which about £50,000,000 is by sea, and £22,000,000 from Great Britain. The countries which have the largest trade with Hamburg, after the United Kingdom, are the United States, the Netherlands, and Norway and Sweden. The Hamburg American Steam Packet Company has ten first-class vessels running regularly between Hamburg and New York. These steamers convey the German mails to the United States, and a very large number of emigrants. Steam communication also exists with New Orleans.

The principal occupations of the artisan class in Hamburg are in the shipyards and engine and carriage-building works. Among the other chief manufacturing establishments are sugar refineries, breweries, distilleries, and furniture and pianoforte factories. There are also cotton mills and a number of manufactories of cement, chemicals and dyestuffs, and machinery. Beef and pork are cured largely for exportation. All employments are, however, subordinate in Hamburg to those of commerce and navigation.

The annual revenue and expenditure of Hamburg are each about £1,750,000. The public debt in 1884 was £7,000,000. A considerable part of this sum was incurred after the great fire in 1842, and spent in rebuilding the city on a new and improved plan. The whole damage caused by the conflagration—which laid more than 5000 buildings in ashes—was estimated at the time at 90,000,000 thalers, or about £15,000,000 sterling.

Hamburg communicates with Lübeck by a canal and railway, and with Berlin, Brunswick, Altona, Kiel, Hanover, &c., by railway.

HAMIL'CAR, a name renowned in Carthaginian annals. The name signifies in Tyrian "gift of Herakles," the Tyrian *Milcar* or *Melkarth* being the counterpart of the Greek *Herakles*. The following are specially distinguished:—

1. Hamilcar, son of Hanno, who led the great Sicilian expedition from Carthage, B.C. 480, and perished at Himera; (2) Hamilcar Rhodanus, Carthaginian envoy to Alexander the Great; (3) the antagonist of Agathokles in Sicily, in 317 B.C.; (4) Hamilcar, son of Gisco, who succeeded the former in Sicily, B.C. 311, and was eventually defeated and slain by Agathokles; (5) the brave antagonist of the Roman Consul Regulus both by sea and land; (6) Hamilcar Barca, subject of the next article. There were several others of less distinction.

HAMIL'CAR BARCA, the father of Hannibal, and the great leader of the popular party at Carthage, was appointed in the eighteenth year of the first Punic War (B.C. 247) to the command of the Carthaginian forces. He ravaged with his fleet the coasts of the Bruttii and the Epizephyrian Locrians, and afterwards seized upon a strong fortress in Sicily, between Eryx and Panormus. In this place he maintained himself for some years. He frequently ravaged the southern coasts of Italy as far as Cumæ, and defeated the Roman troops in Sicily. The Romans at length fitted out a fleet to cut off all communication between Hamilcar and Carthage, while the Carthaginian fleet sent to his assistance was defeated by the Roman consul Lutatius Catulus (B.C. 241). The Carthaginians sued for peace, which was granted by the Romans; and Hamilcar led his troops to Lilybæum, whence they were

conveyed to Africa. But a new danger awaited Carthage. The Carthaginian treasury was exhausted; and it was proposed to the troops that they should relinquish a part of the pay which was due to them. The soldiers rejected the proposal, and proceeded to enforce their demands. Being joined by many of the native tribes of Africa, they defeated Hanno, the Carthaginian general sent against them, and brought Carthage to the brink of ruin. Hamilcar, being appointed to the command, on his return to Carthage from concluding the peace, succeeded in subduing them after the war had lasted above three years. The striking novel "Salammbô" of M. Gustave Flaubert gives a magnificent and historically accurate account of this exciting contest.

Hamilcar next formed the brilliant design of establishing a new empire in Spain, with the plan of invading Rome by land, eventually carried out by his son Hannibal. Hamilcar therefore went to Spain (B.C. 238), where he remained nearly nine years, during which time he extended the dominion of Carthage over the southern and eastern parts of that country. He fell in a battle against the natives, B.C. 229. Barca was a surname of honour; its meaning is *the lightning*.

Hamilcar was succeeded in his command in Spain by his son-in-law Hasdrubal, who must not be confounded with his own son Hasdrubal, the brother of Hannibal. Hasdrubal carried on the conquests of Hamilcar, and reduced almost the whole of the country south of the Ibĕrus (Ebro), which was fixed as the frontier of the Carthaginian dominions.

HAM'ILTON, a handsome town of Scotland, in the county of Lanark, pleasantly situated near the confluence of the Avon Water with the river Clyde, 11 miles S.S.E. from Glasgow. It is a parliamentary and municipal burgh and market-town, and has stations on the Caledonian and North British Railways. There is a five-arch bridge over the Clyde and a lofty three-arch one over the Cadzow. The town is the head of a presbytery in the synod of Glasgow. The chief public buildings are several churches and chapels, a grammar-school, a trades' hall and town-hall, market-house and old cross, infantry barracks, race-stand, and several hospitals. The burgh was created by the Reform Act of 1832, and is municipally governed by a provost, four bailies, a treasurer, and ten councillors. The population in 1881 was 18,995. The district is famous for its apples, and the manufactures of the town comprise imitation cambric, sewed muslin, lace, black silk veils, galas, fine thread, &c. In the vicinity there are many coal and iron mines. It is included in the Falkirk parliamentary district, which sends one member to the House of Commons. Hamilton was founded by, and derives its name from, the family of the Hamiltons, originally from Hambleton, in Leicestershire, who are now represented by the Duke of Hamilton, the hereditary keeper of Holyrood Palace. The peerage dates from 1445; the marquisate having been created by James VI. in 1599, and the dukedom in 1648. It had long been understood that to the title also belonged the dukedom of Chatelherault in France, but the claim was only confirmed by decree in 1864. Hamilton Palace, the family seat, is a very handsome Grecian structure, 264 feet long, and formerly contained many valuable paintings and cabinets; but in 1882 the treasures of art were sold. The park in which it stands contains a magnificent mausoleum, erected by Alexander the tenth duke, of which he became the first occupant, and a picturesque and striking copy of the façade of Chatelherault Castle. Cadzow Forest, which adjoins the park, is famous for its oaks, the last relics of the great Caledonian forest which once extended from sea to sea, as well as for a herd of the aboriginal breed of Caledonian wild cattle, which is still preserved in it. The forest likewise contains the ruins of an ancient castle of the same name.

Among historical events connected with Hamilton, the battle of Bothwell Bridge, fought between the Covenanters and the royal forces, under the Duke of Monmouth, in 1672, deserves mention. The result of the engagement was unfavourable to the former, about 400 of whom were killed on the spot, while 1200 were taken prisoners.

HAM'ILTON, a city in Ontario province, Canada, at the west end of Lake Ontario, 38 miles by rail from Toronto, 378 from Montreal, and 45 from the Niagara Falls. It is one of the most prosperous and beautiful cities of the dominion, mainly owing to its situation on Burlington Bay, and on the Grand Trunk and United States Railway. It is the station for steamers from Montreal, and is the seat of extensive commerce. The population in 1881 was 35,065. In 1851 the number was 10,312, and in 1841 only about 3200. The houses are well built of brick or stone, the streets regular and well laid out, and sewerage good. There is also a very ample supply of water from the lake. The principal manufacturing establishments are locomotive works, foundries, and car works. The town is in the centre of a very rich agricultural district.

HAMILTON, ALEXANDER, an eminent American statesman, was born 11th January, 1757, in the British West Indian island of Nevis, one of the Antilles. His father was a Scotch emigrant and his mother was of French Huguenot descent. The latter died while he was yet a child, and soon after his father failed in business, so that at the age of twelve Alexander was entered as a clerk in the counting-house of an American merchant named Cruger, who had an establishment at St. Croix. In this position he displayed such extraordinary ability, that within a year he was left in charge of the business by his employer. In 1772 by the assistance of his friends he was enabled to proceed to a grammar-school at Elizabethtown, New Jersey, and in 1774 he entered Columbia College, New York. He took a lively interest in politics, and heartily supported the rights of the colonies in the disputes that had arisen with the mother country. On the outbreak of war he joined the colonial army, obtaining a commission as captain of artillery, and in January, 1777, he became private secretary to Washington, being raised to the rank of lieutenant-colonel. Having married in 1780 a daughter of General Schuyler he retired from the army in 1782 with the rank of colonel, and resuming the study of the law was admitted to the Supreme Court, and soon acquired a considerable practice. He was elected in 1782 a member of the Continental Congress, a member of the legislature of New York in 1786, and was one of the delegates to the convention of 1787, which met at Philadelphia for the purpose of revising the Articles of Confederation. The plan he suggested was not adopted by the convention, but his influence was fully manifested in the results arrived at by this assembly. Hamilton strongly favoured the principles of federalism, and publicly explained his views in a series of letters to the *New York Daily Advertiser*, being assisted by Jay and Madison. These were afterwards collected and published under the title of "The Federalist." In 1789, when Washington formed his first cabinet, Hamilton was appointed secretary of the treasury, and undertook the herculean task of organizing the finances of the young republic. He found everything in disorder, and his efforts at reform met with fierce opposition from many influential public men; but he succeeded in consolidating the debts of the states, provided by a judicious system of taxation for the extinction of the federal debt, and established a national bank. In 1789 he retired from the cabinet, and resumed the practice of law, becoming the leader of the bar of his adopted state. When war with France was threatened in 1798, he was appointed second in command to Washington, at the latter's earnest request. He strongly opposed the election of Aaron Burr to the presidency of the United States, and the latter, infuriated by his failure,

which he knew was largely owing to the efforts of Hamilton, found means to send him a challenge, and mortally wounded him. He died the following day, 12th July, 1804, in the forty-eighth year of his age, his premature end being regarded in the United States as a national calamity. His writings, with a memoir, were published by his son, John Church Hamilton, in seven vols. (New York, 1857).

HAMILTON, ANTHONY, COUNT DE (1646–1720), the author of the famous "Mémoires de Grammont" (his brother-in-law), one of the accepted models of French prose, was an Englishman by birth. His father was the Earl of Abercorn's brother, and his mother was the Duke of Ormond's sister. He was born at Drogheda in Ireland, but was taken to France when four years old, and remained there till the reign of Charles II. The "Mémoires" are a brilliant memorial of that court, written by Count Hamilton at Sceaux after the fall of James II., whom he accompanied into exile. He took part in the expedition of 1708. He died at St. Germain-en-Laye.

HAMILTON, PATRICK, the first martyr of the Scottish Reformation, was born in 1503 or 1504, in the diocese of Glasgow, probably at Stonehouse, where his father had an estate. He was destined for the church, and was sent to study at Paris, where he took his master's degree in 1520. He was for a time at Louvain, where he became acquainted with Erasmus, and in 1523 he returned to Scotland, and entered the University of St. Andrews, being in 1524 admitted to its faculty of arts. By this time he had fully imbibed the doctrines of the Reformation, and he now began to preach them with such fervour and earnestness that he incurred the enmity of Archbishop Beaton, and was compelled to flee into Germany in 1527. While there he visited Wittenberg and Marburg, making the acquaintance of Luther, Frith, Tyndal, and others of the reformers, and became more fully instructed and confirmed in the new teaching. In the autumn of the same year he returned to Scotland, where he married a young lady of noble family, and recommenced his preaching with renewed vigour and enthusiasm. His noble birth, great learning, blameless character, and unvarying courtesy to all, gave him an immense influence, and attracted widespread attention to his teaching, but this served to arouse both the fears and the anger of the clergy. Beaton was afraid to proceed openly against him on account of the influence of his family, but managed to get him into his power by inviting him to a conference on the state of the church at St. Andrews. Hamilton arrived there in January, 1528, and was suffered for about a month to preach without molestation, but he was constantly watched and attended by spies, who sought to entrap him into the utterance of heretical opinions. At the end of February the plot was ripe, and he was arrested and brought before Beaton on the 29th on the charge of heresy. He answered fully all the written charges made against him, but the council having predetermined on his destruction eagerly found him guilty, deprived him of his ecclesiastical dignities, and having arranged that a warrant from the secular power should be in readiness, handed him over for punishment. The same evening he was burned at the stake, in front of the gate of St. Salvator's College, meeting his fate with a calm courage worthy of his previous life. His preaching and martyrdom made a profound impression on the national mind, and as an opponent expressed it, "the smoke of his pile infected all upon whom it blew." He left a treatise in Latin on the Law and the Gospel, which was translated by Foxe and included in his "Acts and Monuments." (See "Patrick Hamilton; an Historical Biography," by Dr. Lorimer, Edinburgh, 1857.)

HAMILTON, SIR WILLIAM ROWAN, one of the greatest mathematicians of the present century, was born at Dublin, 4th August, 1805. There are few recorded instances in the history of humanity of so great a development of mental power as was exhibited in his childhood. At the age of six he had acquired the elements of Greek and Latin, at ten he commenced the study of mathematics, and at thirteen he was acquainted with thirteen languages, including Arabic, Syriac, Persian, Sanskrit, Hindustani, and Malay. In 1822 he presented to Dr. Brinkley, the astronomer-royal for Ireland, a paper on "Contacts between Algebraic Curves and Surfaces," which gained him the favour of that eminent man, whose admiration of the talents of Hamilton was such that he remarked, "This young man I do not say *will* be, but he *is* the first mathematician of his age." Hamilton entered Trinity College in 1823, and his career as a student is unexampled for its success, and while still an undergraduate he was appointed to succeed Dr. Brinkley in 1827 as astronomer-royal for Ireland and professor of astronomy in the university. In 1828 his "Theory of Systems of Rays" was published, and he presented to the Irish Academy his fine treatise on "Conjugate Functions," and a daring prophecy of the forthcoming higher algebra, entitled "Algebra as the Science of pure Time." In 1833 he predicted, in a paper contributed to the British Association, the existence of conical refraction, the truth of which was subsequently experimentally verified by Professor Lloyd. In 1834 he contributed to the *Philosophical Transactions* his paper on a "General Method in Dynamics." This paper attracted the most earnest attention of the mathematicians of Europe, and the method it indicates has been eagerly studied and developed both in Germany and France. Had this been his only contribution to the science it would have been sufficient to enrol his name among the foremost of the mathematicians of Europe, but a few years later he announced a still greater discovery to the world by his invention of quaternions. See QUATERNIONS.

It is impossible within the limits of this notice to enumerate even the titles of the papers on scientific subjects contributed by him to philosophical journals of his time, but in addition to the subjects already mentioned he wrote upon the dynamics of light, upon fluctuating functions, the calculus of probabilities, definite integrals, &c., contributed to general literature, and was the author of some elegant and thoughtful poetical compositions.

Few philosophers have been more honoured. In 1835 he delivered, as secretary, the annual address of the British Association, and received the honour of knighthood. He was awarded the gold medals of the Royal Society and the Royal Irish Academy, was a member of most of the great scientific societies of Europe and America, and occupied for several years the presidential chair of the Royal Irish Academy. He died 2nd September, 1865. In 1883 appeared the first volume of the fine "Life of Sir W. R. Hamilton" by Robert Perceval Graves, subsequently completed by a second volume (Dublin University Press, 1883–84). Sufficient selections from his writings and his correspondence accompany the "Life" to show that we have in him a second Leibnitz. We see him rising at will at any hour of the night to continue his mathematical work, and we cannot help a smile at the philosopher who, finding his horse "Comet" so refractory as seriously to interfere with a problem he was mentally engaged upon, gave him his head and let him run away, while his master was free to pursue his abstruse calculations. Fortunately the horse only ran home to his stable, and no accident occurred; but to solve quaternions on the back of a runaway animal is certainly a risky adventure.

HAMILTON, SIR WILLIAM STIRLING, one of the greatest philosophical teachers of modern times, was born on 8th March, 1788, within the university buildings of Glasgow, where his father, Dr. William Hamilton, held the chair of botany and anatomy. Sir William's father was a man of considerable talent, of unsullied honour, and

of long descent from one of the oldest Scottish stocks, his particular ancestors having figured conspicuously in history, and been actually ruined in the cause of civil and religious liberty.

The first mental discipline of the future prince of philosophical scholars was under a domestic tutor, and the attending the winter courses in the public schools of Glasgow. In his ninth year he joined one of the classes in the grammar-school, and made considerable progress in the study of the Greek and Latin languages. At the age of twelve he attended the junior classical classes at the university. After a couple of years spent at a school in England, he returned to Scotland, with the intention of becoming a regular member of Glasgow University, and in the session of 1803-4 he joined the senior Latin and Greek classes, as well as those of logic and moral philosophy. From this period, probably, dates his attachment to speculative studies, although it was not until middle age that he finally resolved to devote his powers to philosophy, having at first intended to follow the profession of medicine, in which his ancestors had achieved no little distinction.

In the spring of 1807 Hamilton left Glasgow for Oxford, his distinguished university career in Scotland having secured him the position of Snell Exhibitioner, a post at one time held by Adam Smith. He entered at Balliol College, and continued his academical studies without interruption for three years, when he took the arts degree. During the latter part of his university career Hamilton exerted himself to the utmost, and remained at Oxford during the entire winter of 1809 and summer and autumn of 1810, creating for himself at this time a great reputation both for learning and kindliness.

In the final examination in 1810, the partiality of Hamilton for speculative studies was conspicuously exhibited in the section of "Moral Philosophy and Logic." The books he selected for preparation were far more than were required, embracing the greatest speculative writers of antiquity, and the results of the examination proved his reading to be unparalleled in the history of the university.

In 1812 Hamilton, after considerable research into the history of his family, succeeded in obtaining the verdict of a jury adjudging him heir to Sir Robert Hamilton of Preston, and declaring him entitled to the name and style of Baronet of Preston and Tingalton. Early in the following year he finally decided upon reading for the Scottish bar, and in July, 1813, passed as advocate in Scotland, and took up his residence in Edinburgh. His career at the bar was neither a brilliant success nor an absolute failure; but long before the attainment of his thirty-second year he felt that neither by education, habit, or inclination was he fitted for the jarring life of an advocate.

The death of Dr. Thomas Brown, the professor of moral philosophy, in 1820, appears first to have drawn his attention to the advisability of turning to practical account his great philosophical learning and speculative genius. With the view of obtaining a recognition of his attainments he now became a candidate for the professorial chair. The election, however, turning upon political considerations, Sir William failed; but was in the following year elected by the Faculty of Advocates to the professorship of civil history, and set to work energetically to prepare a course of lectures. His private studies, meanwhile, were actively continued, and in 1826, at the time the pretensions of the craniologists first attracted attention, appeared his celebrated physiological paper on the "Practical Consequences of the Theory of the Functions of the Brain of Dr. Gall." His researches crown the labours of professed anatomists.

In 1829, two years after the death of his mother, Sir William married his cousin, Miss Marshall, who had been brought up with his mother's family during the previous ten years, and the union was in every sense a happy one. The foundation of Sir William Hamilton's European reputation as a thinker was laid by his early contributions to the *Edinburgh Review*, especially by the first, which was a review of the "Cours de Philosophie" of Victor Cousin. After this he was a constant contributor, his articles on Oxford, on the right of admission of dissenters into the universities, on the "Epistolæ Obscurorum Virorum," on the study of mathematics, and above all on logic, showing the same varied learning, breadth of view, and profound knowledge of the subject.

The chair of logic and metaphysics having become vacant, the Edinburgh town council, by a majority of four, elected Sir William Hamilton to it on 15th July, 1836. In the introductory lecture, the reflective listener felt that a new power had arisen in the intellectual world—that the key-note of a higher strain of abstract inquiry than had been heard before in our Scottish universities was now struck. In his professorial career he achieved distinguished success as a teacher. He unquestionably revived the taste for philosophy in Britain, no previous thinker having attempted to teach the youth of his country to reflect for themselves. His aim was not to teach systems, but to teach to philosophize. His hold on his pupils was remarkable, he being regarded by them as the revealer of a new world. In controversy his command of the opinions of his predecessors was extraordinary. In discussing a point of grammar, he quotes the authority of twelve of the most eminent writers of antiquity, and when treating of *attention* he brings in no less than thirty-one authors. The lectures he delivered during this period were edited by Dean Mansel and Professor Veitch, and published after his death ("Lectures on Metaphysics and Logic," four volumes, 1858-60).

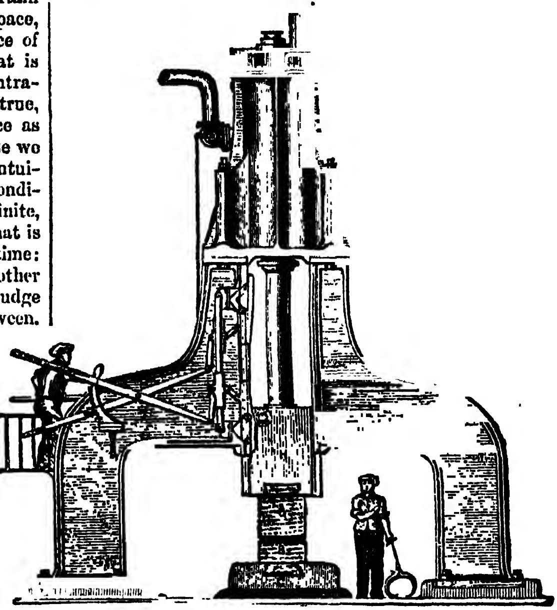
In 1840 Sir William Hamilton was elected a member of the French Academy. In 1846 he completed the editing of Reid, necessarily delayed by declining health. In 1852 he published a volume of essays (consisting chiefly of his contributions to the *Edinburgh Review*), entitled "Discussions in Philosophy, Literature, Education, and University Reform." In 1854 he brought out the first volume of the collected works of Dugald Stewart, to which he had devoted many years' close attention; but his death, on the 6th May, 1856, arrested his career before its completion.

Of the philosophers of modern times he ranks among the very first for erudition, while in his day he had no rival. He is emphatically the Scaliger of metaphysics. No former writer in Britain had illustrated his meaning with such a prodigality of quotations at once apt and acute. No other had culled the honey from the scholastic subtilties which to his contemporaries appeared so barren. His knowledge of Aristotle has, perhaps, never been equalled. Not only was he acquainted in detail with every shade of the master's opinion, not only had he extracted the good from every known edition, he was familiar with every opinion of all the commentators of the middle ages. Aristotle, Reid, and Kant, indeed, may be said to have been his favourite authors in philosophy. The more recondite the writer, the greater seems to have been his pleasure in the pursuit of knowledge. As a pure scholar, as a theologian, if generally less known, he was hardly less distinguished. Another favourite subject was the Latin poetry of the fifteenth, sixteenth, and seventeenth centuries, of which he had a rare and ample collection, and a very thorough knowledge. Sir William Hamilton was emphatically the first British thinker who attempted to grapple with the great problems of metaphysics in anything like an exhaustive manner. His admirers, his friends, his pupils were introduced to a new field, and the writings of continental thinkers came for the first time to have a real significance in Britain. In an age eminently materialistic, he led the way, in his article on Cousin, to the humanizing influences of a purer philosophy. In the words of the late

Professor Ferrier, "A simpler and grander nature never arose out of darkness into human life; a truer and a manlier character God never made. How plain and how polished his intelligence in all its workings! . . . His contributions to philosophy have been great, but the man himself was far greater." In addition to the works mentioned some selections from his MSS. were published by Dean Mansel in 1862. A criticism of his system of philosophy, by J. S. Mill, was published in 1865, and an appreciative memoir of Sir William Hamilton, by Professor Veitch of Glasgow University, was issued in 1869.

Perhaps Sir William Hamilton's greatest contribution to metaphysics is his "Law of the Conditioned," certainly a very remarkable and vast conception. Excluding certain absolutely known things, such as one's own existence, space, time, &c., all else, he avers, suffers from the impotence of our faculties. The law is thus expressed: "All that is conceivable in thought lies between two extremes contradictory of each other, which cannot therefore be both true, but one of which must be true." Thus we know space as existing, but if we try to make our knowledge precise we find the mind impotent to go further than the vague intuition. What we know comes under the law of the conditioned. Space is unthinkable either as finite or as infinite, and yet it must be either the one or the other; what is conceivable of it lies between the extremes. So with time: things had a beginning or they had not: one or the other is undoubtedly the case, but our mind is impotent to judge of these extremes; we only can conceive what lies between. Hamilton applies the same argument to causality, and declares that the notion of cause and effect is in fact but an impotence of the mind—one case, indeed, of the law of the conditioned. Either things began without a cause (something was created out of nothing), or creation was merely rearrangement of pre-existing matter. But we can neither think of matter as eternal nor as being created out of nothing; all we know lies between those extremes. Therefore, says Hamilton, when we find our intellect claiming that all things follow definite causes, while yet our mind knows itself to be perfectly free in choosing its own course, we are not (as we otherwise should be) at a deadlock. For we say that this universality of cause and effect is only a case of the limitation of the human mind, and cannot weigh against the testimony of consciousness. Proud of this subtle reasoning the great philosopher proclaimed his law not only the foundation of morals, but the only doctrine whence we can philosophically infer the existence of God. In his "Examination of Sir W. Hamilton's Philosophy" John Stuart Mill justly complains of his "grave offence against the morality of philosophic inquiry," by prejudicing the inquirer's mind with so strong an assertion.

HAMMER. Of all the tools used by man the hammer in its various forms is the one that is most useful and important. A great variety exists in the shapes and sizes of the hammers used in mechanical work, though they are nearly all modifications of the common form adapted to special requirements. The common hand hammer consists of a long wooden handle, to which is fixed crosswise a metal head, generally iron or steel, or iron faced with steel. Many hammer heads are made with one side flat for striking the work, termed the *face*, and the other side lengthened and flattened out to a wedge shape or a point, which is called the *pane* of the hammer. In the carpenter's hammer the pane is curved round in the direction of the handle, and ends in a V-shaped notch for drawing nails; many other useful shapes have been designed for the panes of hammers used in metal work, &c. The heaviest hand hammers are those which are used by the "strikers" in forging, known as sledge hammers, of which the head sometimes weighs between 20 and 30 lbs. By using a number of hammermen who were trained to strike in rapid succession, it was found that very large masses of metal could be forged; but with the progress of the mechanical arts a greater degree of hammer power became necessary, and as is usually the case in invention, the attempt was made to imitate on a larger scale the work done by the hand. The *helve hammer*, which for a long period was the only power-hammer known, consisted of a long metal handle, generally of cast iron, and a heavy head of wrought iron faced with steel. The end of the handle furthest from the head was attached to an axis, and the head of the hammer was raised by a series of cams attached to a heavy wheel and



Double-acting Steam Hammer.

allowed to fall by its own weight. Another kind of power-hammer of a lighter nature, and designed to strike more rapid blows, was the *tilt* hammer, which was lifted by striking down a projection from the handle extending beyond the axis by the cams of a large wheel. The wheels used to move these hammers were in the first instance moved by water-power, but afterwards steam was introduced for this purpose, and the implements were termed steam hammers. When the latter term is used now, however, it applies to an instrument designed on a totally different principle, first introduced by Mr. James Nasmyth in 1843. His designs were drawn up in 1838, and a hammer of the kind he indicated was constructed at Creuzot by M. Schneider, before the invention was tested in England, in the beginning of 1843. The first designs were soon improved upon, and the same year the most important addition to the designs of Mr. Nasmyth that has been made was introduced by Mr. Robert Wilson in the self-acting valve gear, which imparted an immense power of adjustment to the instrument.

In the *single-acting steam hammer* the hammer rises and falls in a vertical straight line, and consists either of the piston with its rod carrying the hammer-head (as in Nasmyth's form), or of the cylinder and hammer-head (as in Condie's form). It is suitably faced with steel at the lower end. It is lifted by the pressure of steam admitted into a vertical cylinder; and so soon as it has been lifted to the proper height, the steam is allowed to escape, and the

hammer falls through the unassisted action of gravity, and strikes a blow of an energy proportional to the product of its weight and the stroke or depth of fall. In the *double-acting steam hammer*, shown in the illustration, the pressure of the steam acts alternately in both directions, and co-operates with the force of gravity to increase at once the energy and the frequency of the blows. The admission of the steam into the cylinder is usually regulated by means of a slide-valve, which may be either hand-worked or self-acting—being moved in the latter case by means of suitable mechanism acted upon by the motion of the hammer itself. In either case the extent of stroke and the force of the blow are capable of very delicate adjustment, so that the same hammer which is used for forging propeller-shafts can be made to crack a nut without crushing the kernel. The piece of work to be hammered usually lies upon an anvil, the weight of the anvil-block being from six times to ten times that of the hammer; the building of a foundation suited to sustain the shocks given by the hammer is always a very difficult and expensive affair.

In an ingenious invention known as the *duplex steam hammer*, two equal and similar hammers are driven by the pressure of steam horizontally in opposite directions, so as to strike the piece of work with equal force on opposite sides at the same instant. The great weight and massive foundation of the anvil-block are thus made unnecessary. Steam hammers vary in weight from 1 or 2 cwts. to more than 40 tons, and their length of stroke ranges from a few inches to 12 feet and upwards. Enormous as the power is of a steam hammer of 40 tons driven by the force of steam, it has been found inadequate for the forging of the monster pieces of artillery now designed for naval warfare, and hammers of much greater power have been prepared at Woolwich, Essen, and elsewhere. But the successful application of hydraulic pressure in the production of these monster forgings is likely to limit the further development of steam hammers for those purposes.

HAMMER-BEAM ROOF, in architecture, is a splendid roof, almost absolutely confined to English architecture of the fifteenth century. It derives its name from the use of a "hammer-beam," or large bracket projecting from the external walls, to partly support the rafters. The finest example in the world is the famous roof of Westminster Hall. Another fine specimen is the roof of the great hall in Hampton Court Palace, which is engraved in the Plates illustrating ENGLISH CATHEDRAL ARCHITECTURE.

HAM'MERFEST, a town of Norway, in the Arctic Ocean, included in the amt of Finmark, and situated on the island of Kvalo, 14½ miles S.W. of the North Cape. It is the most northern town of Europe, and though little more than a village in size, is well built, and has several churches and schools, a library, and a museum. There are some copper works at Kaafiord; but the chief importance of the town is derived from its connection with the fisheries of the northern seas. It is within the latitude of uninterrupted sunlight for two months together, and has several times been the scene of important scientific observations.

HAMMER-HEAD or **HAMMER-HEADED SHARK** (*Zygæna malleus*), a shark distinguished from all others by the peculiar shape of its head, which is dilated on either side so as to resemble a double-headed hammer. The eyes, which are very large, are placed at the extremity of these lateral prolongations; they are gray, prominent, and have a gold-coloured iris. When the animal is irritated, the irides seem to light up with a sudden flame, much to the horror, it is said, of the fishermen who behold them.

The mouth, which is semicircular, is placed beneath the head, and near to the junction of the trunk. It is furnished in each jaw with three or four rows of large teeth. The nostrils open in front of the head. The hammer-head is found in nearly all tropical and subtropical seas. It is scarcely less formidable for voracity and fierceness than the ordinary shark, attacking any person who may be unfortunately bathing in its vicinity. Specimens caught in the British seas are long and slender in the body, which is gray, with a blackish-coloured head. They usually attain the length of 10 or 11 feet, and weigh from 400 to 500 lbs. The voracious fury of this shark often brings it round vessels even in the roadsteads and close in upon the coast. Four other species of this singular genus are known, chiefly inhabiting tropical seas.

HAMMER-OYSTER (Malleus) is a genus or subgenus of Molluscs belonging to the family AVICULIDÆ or wing-shells. Six species are known from China and Australia. The shell bears considerable resemblance to the implement from which it takes its name. The valves are blackish, nearly equal, somewhat rugose on the outer surface, and on the inner often brilliantly nacred. Being enlarged on either side of the hinge, the prolongation gives them an outline like that of the head of a hammer; and as they grow in a direction opposite that of the hinge, the extension is not unlike its handle. When young the hammer-oysters are very like species of the genus Avicula.

HAM'MOCK. In various parts of South America it is the custom of the natives to fasten the two ends of a piece of coarse cloth or net to the branches of trees, into which they then climb and lie suspended at their ease. This is called a *hamac*. Maritime nations have adopted the custom for the sailors' beds on shipboard. A sailor's hammock is a piece of linen cloth or canvas, about 6 feet long and 3 wide, with cords attached to each end, and hung on hooks under the deck. They are placed in rows about 2 feet apart, and are taken down every morning and stowed away. Each hammock contains a mattress and blankets, and forms the most comfortable kind of bed during a voyage. In ships of war the hammocks, rolled up tightly with the beds and bedding and placed in a net, are used during action as a means of protection against rifle bullets.

HAMP'DEN, JOHN, the famous defender of English liberties, was the eldest son of William Hampden and Elizabeth, second daughter of Sir Henry Cromwell and aunt of the protector, Oliver Cromwell. His father died when he was only three years of age, and left him heir to an extensive estate. He was educated first at the grammar school of Thame, and then at Magdalen College, Oxford, which he entered when he was fifteen years of age. At nineteen he was admitted a student of the Inner Temple, and closely applied himself to the study of law, in which, as well as in general scholarship, he acquired great proficiency. In 1619 he married Elizabeth Symeon. During his early years Hampden is said to have mingled freely in the pursuits which were fashionable among men of large fortune at that period, but about the time of his marriage his character underwent a remarkable change. He adopted the religious principles and virtuous habits of the Puritans, became noted for "an extraordinary sobriety and strictness," without any asceticism or austerity, however; for Clarendon admits that after the change in his habits Hampden "preserved his own natural cheerfulness and vivacity, and above all a flowing courtesy to all men." At this period, too, he entered upon public life, and in 1621 took his seat in the House of Commons as member for Grampound. He did not take any prominent part in public affairs during the life of James, though he acted cordially with the country party against the unconstitutional and oppressive measures of the court. He sat as burgess for Wendover in the first two Parliaments of Charles I., and in the second he supported his friend, Sir John Eliot, in his attack upon the king's worthless favourite, Buckingham. Charles dissolved the Parliament, and had recourse to a forced loan for the purpose of replenishing his exhausted exchequer. Hampden peremptorily refused to comply with this arbitrary demand, and was in consequence imprisoned first in the Gatehouse, and afterwards

in Hampshire. A war with France constrained Charles reluctantly to summon another Parliament in 1628, and to release those patriots who had been imprisoned for their refusal to comply with his illegal demands. Hampden regained his liberty, and was once more returned for Wendover. Though he had taken a deep interest in the important contest which raged round the Petition of Right, and sympathized strongly with the popular party, he was not one of the prominent debaters in the House, and he retired to his beautiful residence in Buckinghamshire when the Parliament was abruptly dissolved by the baffled king in 1629, and diligently discharged the duties of a great landed proprietor and an active magistrate. In 1634 he lost his wife, to whom he was devotedly attached, and who had borne him ten children. This heavy domestic calamity is believed to have deepened the interest which he took in public affairs. In 1636, at the instigation of Chief-justice Finch and Noy the attorney-general, an attempt was made by the king to levy ship-money from the inland counties—a new and most arbitrary stretch of power. Hampden at once refused to pay this illegal impost, and though a majority of the judges, who had previously been tampered with, decided against him, yet, as Clarendon admits, "the judgment proved of more advantage and credit to the gentleman condemned than to the king's service." The case lasted three weeks and three days, and occupied all the twelve judges. Only two of them were favourable to Hampden. So dark, however, grew the aspect of affairs that Hampden, Cromwell, Pym, Lords Saye and Brooke, and other leading patriots, resolved to take refuge in America, and were actually on board the ship in which they had taken their passage when it was prohibited from sailing by an order of council. In the Parliament which assembled in the spring of 1640 Hampden took his seat as member for Buckinghamshire, and was regarded as one of its most prominent members. In the course of a few weeks this Parliament was dissolved by the king in a great rage (5th May), and several of its members were as usual thrown into prison. Its successor—the memorable Long Parliament—which met on the 3rd of November, 1640, at once proceeded resolutely to work in redressing the grievances of the country. The foremost place in its councils was by universal consent assigned to Hampden. Clarendon, a hostile witness, speaks in the highest terms of his talents for business as well as for debate, his industry, vigilance, and acuteness, and his remarkable ability in the management of men, and says, "The eyes of all men were now fixed upon him as their *patriæ pater* and the pilot that must steer the vessel through the tempests and rocks which threatened it." Hampden, though acting with great mildness and moderation, took a prominent part in the impeachment of Strafford, the punishment of Finch, Windebank, and other servile tools of the king, and in the abolition of the star-chamber and the high-commission court. In the following session he strenuously supported the Grand Remonstrance, and it was by his calmness and sagacity that the excitement of the House, during the violent debate on that address, was allayed, and the members were prevented from proceeding to personal violence. He was one of the five members whom the king attempted illegally to arrest in the House on a charge of high treason. When hostilities actually commenced Hampden strove with characteristic energy and vigour to bring the question at issue to a speedy decision. He subscribed a large sum to defray the expenses of the war, and raised a regiment of infantry in Buckinghamshire, of which he was made colonel. His zeal in acquiring a knowledge of his military duty was as conspicuous as his courage and activity, and it soon became evident that his talents for war were not inferior to his talents for government. When Hampden drew the sword he threw away the scabbard. It was to Hampden that Cromwell complained, as he himself told his Parliament (Speech, 13th April, 1657), that the Parliament's men were necessarily beaten at every hand. "Your troops, said I, are most of them decayed serving-men, and tapsters, and such kind of fellows; and their troops, said I, are gentlemen's sons, younger sons, and persons of quality: do you think that the spirits of such base and mean fellows will ever be able to encounter gentlemen that have courage and resolution in them? You must get men of a spirit that is likely to go on as far as gentlemen will go, or you will get beaten still." Out of which famous discussion with Hampden came Cromwell's famous pattern regiment of "Ironsides," the first redcoats, who were never once beaten, and whose honourable livery has ever since been in peculiar favour with English soldiers. It is probable that if Hampden had lived he would have superseded the dilatory Essex in the supreme command; but unhappily for his country his brilliant career was now near a close. On the 17th of June, 1643, he was mortally wounded when heading a skirmish at Chalgrove Field, near Thame in Oxfordshire, and died on the 24th, in the forty-seventh year of his age. His death caused the most profound grief throughout almost the whole kingdom. Hampden was undoubtedly one of the purest, most disinterested, and upright patriots our country has ever produced. His abilities both as a statesman and a debater were of the highest order, while his integrity, prudence, modesty, affability, and consummate address gained him the esteem and confidence even of his opponents, on whom, as Clarendon admits, "he always left the character of an ingenuous and conscientious person.' He was peculiarly reticent and self-possessed; a man of few words, sagacious, calm, and cautious, with an indomitable will and energy which nothing could turn aside or subdue. Never did a man inspire a nation with so much confidence.

HAMP'SHIRE (familiarly, *Hants*), a county of England, between 50° 34′ and 51° 22′ N. lat., and 0° 48′ and 1° 54′ W. lon. It includes the ISLE OF WIGHT, and is bounded N. by Berkshire, E. by Surrey and Sussex, S. by the English Channel, and W. by Wiltshire and Dorsetshire. The length of the mainland portion of the county from north to south varies from 37 to 46 miles, the breadth from 28 to 41 miles. The area of the county, including the isle, is 1625 square miles or 1,032,105 acres. The population in 1881 was 593,487.

Surface, Geology, &c.—The coast is low towards the east, where there is a wide bay or inlet, divided by Hayling Island and Portsea Island into three parts: Chichester Harbour on the east, Langston Harbour in the middle, and Portsmouth Harbour on the west. The coast from Portsmouth Harbour to Southampton, up the Southampton Water, is mostly flat; as is also the further portion westward which forms Christchurch Bay.

The surface of this county is rather irregular. The South Downs enter it from Sussex on the south-east, near Petersfields, and cross it in a north-west direction into Wiltshire. The North Downs enter the county from Surrey, near Farnham, and extend across by Odiham, Basingstoke, and Kingsclere, into Wiltshire. The Alton Hills form a connection on the east side of the county between the South and North Downs, and run from Petersfield northwards past Alton. Portsdown is an isolated eminence, extending east and west just above Portsmouth and Langston harbours; its height is about 447 feet, its length 7 miles, and its breadth a mile.

A large part of Hampshire is within the basin of the Southampton Water. The principal streams which drain the Southampton basin are the Avon or Test, the Itchin, and the Hamble. One branch of the Test rises near Hurstbourne Tarrant, and another near Whitchurch; their united stream flows by Stockbridge and Romsey to Southampton. The Itchin rises in the hills around Alresford, and flows past Winchester to Southampton. The Hamble rises near Bishop's Waltham, and joins the Southampton

Water some miles below Southampton. The Beaulieu River and the Boldre Water flow through the New Forest. None of these are above 35 miles long. The Wey, the Aubourne, and the Loddon flow into the Thames basin; the Rother into the Arun basin; and the Avon and Stour flow into the Wilts and Dorset basin.

The county is intersected by the London and South-western Railway, with several branches, and the South Coast Railway terminating at Portsmouth.

That vast district of chalk which overspreads so large a portion of Wiltshire, and of which Salisbury Plain forms a part, extends into Hampshire, and occupies a considerable part of it, constituting the North and South Downs and Portsdown. North of the chalk the strata belong to the London basin; south, to the Isle of Wight basin; east, to the Weald strata; west, to the chalk of Wilts and the plastic clay of Dorset.

The New Forest in this county has varied in area from time to time; at present it includes 63,000 acres, and is the property of the crown, subject to rights of common and other ancient claim. The relative rights of the crown and of commoners have formed the subject of frequent disputes, which were settled in 1880 by an Act which confirmed to the crown its right of inclosing and planting over 16,000 acres of what is really the most valuable land in the forest. Much of the oak and beech for the navy was formerly grown here. Bere Forest extends northward from Portsdown Hill, and its bounds comprehend about 16,000 acres, of which one-third is inclosed. Alice Holt and Woolmer Forest contain together about 15,000 acres. Besides these forests there is a waste of about 2000 acres, called Waltham Chase, situated near Bishop's Waltham.

Climate and Agriculture.—The climate of Hampshire is generally mild and favourable to vegetation.

The northern part of the county consists chiefly of the poor dark sand, mixed with an ochreous loam, which is well known as the Bagshot-Heath soil. It is naturally very unproductive, and till within a few years was almost entirely covered with a brown heath, on which some hardy forest sheep and a few miserable cattle were reared and contrived to pick up a scanty living; but a good deal of heath has been brought into cultivation. South of this district the chalk prevails, which is better for pasturage than for corn culture. In the valleys and along the lower slopes of the chalk hills the soil is of a tough tenacious nature, being a mixture of stiff clay with chalk washed down the hills by the rains. This is a soil very difficult to cultivate, but it can be made to yield good crops of beans, wheat, and oats.

The land in the New Forest, and on the opposite side of the Southampton Water, is mostly of a light nature, intermixed here and there with heavier loams and clays. It requires careful drainage to make it fertile. The county generally may be said to possess poor soils. Much waste land has been inclosed of late years, a large portion of it having been brought under tillage, but other parts are merely planted with fir and other timber trees.

Hampshire, although it is not equal to some eastern and northern counties for agricultural improvements, is not far behind them; and there are some farms as well managed as any in England. The farm-buildings and the agricultural implements have greatly improved of late years.

The chief corn crop is wheat, for which the county is celebrated. Barley and oats are also somewhat extensively grown, and so are beans and pease. The green crops are chiefly turnips and swedes. Clover and artificial grasses are more largely grown than in any other southern county. According to the official agricultural statistics published in 1884 there were 71,000 acres under cultivation, 230,000 acres being devoted to corn, 180,000 to green crops, 110,000 to clover, and 210,000 to permanent pasture.

There are no breeds of cattle, horse, or sheep peculiar to Hampshire, unless we consider the small New Forest ponies in that light. The cows are of various breeds. The oxen are chiefly Sussex and Devon. Much more attention than formerly has recently been given to the rearing of horses, and some fine and useful animals are now bred. The most general kind of sheep is a short-woolled variety of the South Down, which seems admirably adapted to the county, and has become so identified with it as to be now generally known as the Hampshire "short-wool." The live stock in the county in 1884 consisted of 65,000 cattle, 450,000 sheep, and 65,000 pigs. The native hogs, which live on the acorns and beech-mast of the New Forest, although the flavour of their flesh may be good, are coarse, raw-boned, flat-sided animals, and are now seldom met with. The improved breeds produced by crosses of the Berkshire, the Suffolk, Essex, and Chinese pigs, are those from which the Hampshire bacon is usually prepared. The excellence of this bacon is mainly due to the care with which the curing is effected.

The manufactures of Hampshire, except those connected with the dockyard and shipping establishments at Portsmouth and Southampton, are of little more than local importance. Aldershot, on the borders of Surrey, is famous for its military camp, capable of accommodating 20,000 troops.

Divisions and Towns.—Hampshire is divided into fourteen divisions, comprehending thirty-nine hundreds. It is included in the diocese of Winchester and the western circuit. The assizes are held at Winchester. For parliamentary purposes the county is divided into five districts, each of which returns one member to Parliament, and the Isle of Wight, which also returns one, besides which Winchester and Christchurch return one member each, and Portsmouth and Southampton return two members each, under the provisions of the Reform and Redistribution Acts of 1885.

History and Antiquities.—Before the Roman invasion the county was inhabited by three tribes: the Regni, who occupied the coast as well as the counties of Sussex and and Surrey; the Belgæ, in the middle; and the Atrebates, to the north. This part of the island was reduced by the Romans under Vespasian. Winchester was the Roman station *Venta.* There are also remains of Roman stations at Silchester, and at Broughton. Hampshire was included in the early English kingdom of Wessex, and *Venta* (now Wintanceaster) became the seat of government, and, upon the predominance of Wessex, the metropolis of England Hampshire was the scene of continual contests during the invasion of the Danes, who ravaged the Isle of Wight in the reign of Ethelred II. In the New Forest occurred several disasters to the family of William the Conqueror. His son Richard lost his life here, by what Camden describes as a "pestilential blast;" his grandson Henry, son of Robert, was entangled among some branches and killed while hunting; and his successor William II. was shot here in 1100.

Dialect.—This is very remarkable; for example, the saying, "In Hampshire everything is called *he* except a tom-cat," is true, if to cats we add waggons and saws, all which are called *she.* In general the pronunciation goes with that of the south-western counties, flattening *f* and *s* into *v* and *z*, and *th* into *d* (as *droo d' vorezt* for "through the forest"), &c. See "Hampshire Glossary," by Rev. Sir W. H. Cope, Bart., London, 1884.

HAMPTON COURT CONFERENCE was held from the 12th to the 18th January, 1604, in the presence of James I., for the purpose of settling the disputes that had arisen between the Puritans and the Episcopalians. The former, who had suffered considerably during the latter years of the reign of Elizabeth, hailed with joy the accession of James, who had been bred a Presbyterian, and who had previous to his coronation made them several promises. Hence they at once addressed him in a petition called the

Millenary, because it was signed by nearly 1000 ministers, in which they embodied the principal changes they desired. The king, however, had already decided to favour the Episcopalians, and he appears to have adopted the device of a conference as the easiest method of refusing the requests of the Puritans. The assembly was attended by Whitgift, the archbishop of Canterbury, eight bishops, six deans, and an archdeacon, on behalf of the Episcopalians; and by Reynolds and Sparks, two professors of divinity from Oxford, two divines, Knewstubbs and Chaderton, from Cambridge, and the Rev. Patrick Galloway of Perth, on behalf of the Puritans. The Episcopalians were first admitted to the king on 12th January, on the 16th the Puritans and some of the Episcopalians attended together, and on the 18th the royal judgment was delivered. Some small concessions were made to the Puritans, consisting of a few slight alterations in the Book of Common Prayer; an addition to the Catechism of the part respecting the sacrament; that baptism should be administered only by a lawful minister; that no part of the Apocrypha repugnant to Scripture should be read; and on the suggestion of Dr. Reynolds a new translation of the Bible was undertaken. The victory, however, remained with the Episcopalian party on all the main points of the controversy, and the king took advantage of the occasion to browbeat the Puritan representatives in the presence of their opponents, or, as he pleasantly expressed it, he "peppered them soundly." The Puritans throughout the kingdom were greatly dissatisfied with the result of the conference, and their representatives, who had been chosen without the concurrence of the party, were severely blamed for not doing justice to their cause.

HAMPTON COURT PALACE is in the parish of Hampton and county of Middlesex, 15 miles from the city of London. It has been the favourite residence of many sovereigns, and is still one of the finest of the royal palaces in England. The river Thames flows under its walls. The original building was erected by Cardinal Wolsey, and many sumptuous entertainments were here given by him. Henry VIII. enlarged it and stocked the park with deer. Here Edward VI. was born, and his mother, Queen Jane Seymour, died in 1537. Elizabeth held grand Christmas festivals in it in 1572 and 1592. Charles I. was imprisoned in this palace, and Cromwell, Charles II., and James II., made it an occasional residence. William III. and his queen also abode here, and in great measure rebuilt it and laid out the extensive gardens in their present style. Hampton Court Palace consists of three principal quadrangles, with some smaller courts, the eastern and southern fronts having been erected by Sir Christopher Wren. The picture-gallery comprises Lely's "Beauties of the Court of Charles II.," valuable specimens of Holbein, Kneller, West, Rembrandt, and numerous other celebrated painters—in all, more than 1100 pictures. Many of the ceilings and walls were painted by Verrio. The palace, with the gardens, wilderness, and maze, forms a great attraction to visitors, who are admitted free every day throughout the year except Fridays and Christmas Day. The celebrated vine of Hampton Court, said to be the largest in Europe, may also be seen on payment of a trifling fee. It bears on an average 2500 bunches of grapes annually, which are specially set apart for the royal table. A portion of the palace is now divided into suites of apartments, which are occupied by persons of rank who have been reduced in circumstances.

HAM'STER (Cricetus) is a genus of Rodents belonging to the extensive family Muridæ. The hamsters are distinguished from the true mice by the possession of several large cheek-pouches. The Common Hamster (*Cricetus frumentarius*) is a well-known European animal, found in various parts of Russia, Germany, and especially in Thuringia, as well as in Siberia. It lives in subterranean holes, where it hoards up large stores of grain. It is torpid during the winter months. The fur is grayish-yellow above, and black inferiorly, and it is marked by three spots on each side; these marks being sometimes light-coloured, and at other times quite black. The hamster is about 10 inches in length, with a stout rat-like body, short legs, and a short tail. This little animal is remarkable for its courage and pugnacity. Besides corn, roots and fruits, and other vegetable substances, the hamster preys on small mammals, lizards, &c. The hamster is extremely prolific.

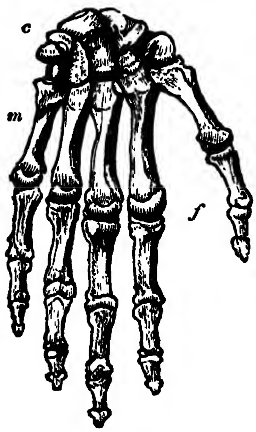
HAMSTRINGS are the tendons of the three powerful muscles which flex the leg upon the thigh and then extend the thigh upon the pelvis, as in walking or running; but their still more important function is when the leg is their fixed point, for they then prevent the pelvis and trunk from falling forward, and maintain the erect posture of the body, acting as a lever of the first order. In walking the hamstring muscles are levers of the third order. These important muscles are:—(1) The *biceps*, arising (in common with No. 2) from the lower surface, tuber ischii, of the pelvis or hip-girdle, with a second head or origin, chiefly from the outer side of the linea aspera, both heads uniting and passing into a tendon or hamstring, which is inserted into the outer side of the head of the fibula. (2) The *semitendinosus*, arising with the long head of the biceps, and whose long slender tendon is inserted into the inner side of the tibia. (3) The *semimembranosus*, at first a strong tendon also arising from the tuber ischii, but from its upper surface, and spreading as it passes downwards into a broad tendinous surface bearing muscular fibres. It ends in a strong tendon passing horizontally beneath the internal lateral ligament of the knee to the groove in the side of the inner tuberosity of the tibia.

HA'NAU, a town of Germany in the province of Hesse-Nassau, near the confluence of the Kinzig and the Main, 99 miles south of Cassel. It is divided into the old and new town, and though well built has few buildings of much importance. There are an ancient castle, several fine churches, a synagogue, a theatre, barracks, arsenal, orphanage, infirmary, and numerous educational institutions. Near the town is the electoral palace of Philippsruhe with its famous orangeries, and on the banks of the Main the baths of Wilhelmsbad. It has an active trade in timber, wines, and saffron, and an extensive manufacture of gold and silver trinkets, ornamental articles of iron, carpets, velvet, silks, stockings, hats, gloves, woollens and cottons, tobacco, and cutlery. Many of its inhabitants are descendants of Dutch and Flemish immigrants, who fled thither from the persecutions in the Low Countries under Philip II., early in the sixteenth century. Here, on the 30th October, 1813, Napoleon, on his retreat from Leipzig, gained a decisive victory over a very superior force of Bavarians and other allied troops under Marshal Wrede. The population is 23,000.

HAND. The bones of the human hand and its principal muscles, and the way in which it is connected with the arm, are fully illustrated in the two Plates of the article ARM (Arm, Shoulder, and Hand). Referring to those Plates we have in Plate I. fig. 15, a general view of the whole. P is the *radius*, M the *ulna*, bones of the forearm; Q to W are the bones of the wrist or *carpus*, and are in detail as follows:—Q, *scapuloid;* R, *semilunar;* S, *cuneiform;* T, *trapezial;* U, *trapezoid;* V, the *great* bone; and W, the *unciform;* X are the metacarpal bones, forming the body of the hand; Y are the fingers. The bones of the wrist are shown better separately, and each of them in two positions, in fig. 14, where *a* is the scaphoid, *b* the semilunar, *c* the cuneiform, *d* the pisiform (a little bone like a split pea, placed in the front of the cuneiform, and not shown in fig. 15), *e* the trapezial, *f* the trapezoid, *g* the great, and *h* the unciform bone. Fig. 11 shows in like manner a detached metacarpal bone in two positions,

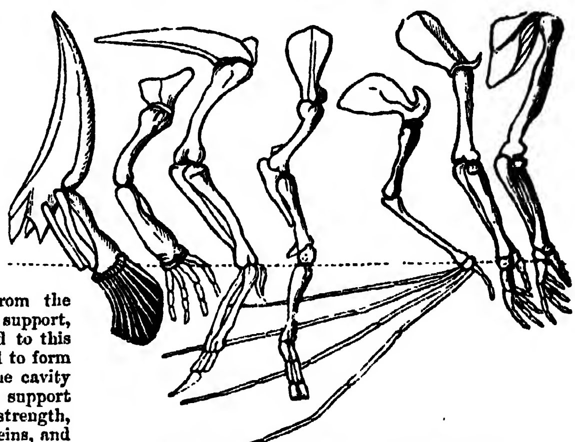
fig. 12 the three bones of one of the fingers, and fig. 13 the bones of the thumb. In these the upper ends or bases (*a*) are shallow cups, and the lower ends or heads (*b*) are convex from before to behind, but concave from side to side. The tips of the short end bones of both fingers and thumbs (*b*), instead of carrying heads as the rest, carry flattened enlargements slightly like the bowl of a spoon, giving room for the expansion of the nerves of touch in front and the attachment of the nails behind. At the base of the first joint of the thumb (and also of the little finger) a pair of very small bones, called sesamoid, are often found.

The hand therefore consists of twenty-seven bones, and is divided into three parts, analogous to those of the foot. The solid part entering into the wrist-joint is properly called the wrist, or *carpus*, corresponding to the *tarsus* in the foot, but for obvious reasons greatly smaller, both in itself and in relation to the rest of the hand. Five long bones come next, making the palm, and fourteen very movable pieces superadded complete the fingers and thumb. In its construction the whole hand differs from the foot, on account of its being intended, not for support, but to catch with, and all its parts are adapted to this end. Eight small bones are pretty firmly united to form the wrist, presenting a ball superiorly to enter the cavity in the lower end of the radius, fitted inferiorly to support the bones of the palm, arched behind to give it strength, and concave in front to permit the bloodvessels, veins, and sinews to run to the fingers without being subjected to undue pressure. Examining the carpus or wrist, and excluding the pisiform bone, we find the remaining seven bones of the wrist divided into two rows, three bones joining on to the two bones of the forearm, and between them making a ball-and-socket joint of great beauty, and four bones joining to these three. We go thus from two to three and to four bones, and even on to five bones in succession of rows, for the five bones of the metacarpus join on to the inner four of the carpus. The radius is seen to carry the scaphoid and semilunar; and the scaphoid carries the trapezial and trapezoid, which respectively end the thumb and the first finger, the semilunar taking the middle finger completely. The ulna carries the cuneiform, on which turns the unciform bone, carrying the third and fourth fingers. The whole seven (eight with the pisiform) are as strong as one mass of bone, with the additional advantage of perfect mobility among the parts, and of freedom from injury through the elasticity of the various joints. The entire mass is convex at the back and concave beneath. The extensor tendons run over the back of the wrist, and the flexors beneath its face. In the palm we see the principal difference between the hand and the foot. In the latter all the bones of the instep lie in one direction, immovable, and serving only to rest on. In the former, four of the bones of the palm are placed side by side, to form the hollow of the hand, and to support the fingers; while another, supporting the thumb, is very movable, and is capable of being brought opposite the others, so as to grasp firmly anything between it and them. The bones of the fingers are larger than those of the toes, and much more movable, but are formed on a similar model. The fingers have each three bones, the thumb only two.



Front view of Left Hand.

c, The eight bones of the carpus; *m*, the five bones of the metacarpus; *f*, the fourteen pieces of the fingers and thumb.



The Manus (hand) of some of the Vertebrates.

The bones of the hand vary considerably, according to their offices, in the different orders of vertebrate animals. The small round bones composing the wrist are found with more or less modification in all. But the hand of man is by far the most perfect extremity in all creation. The ape, who comes nearest to him, has the thumb very short and weak, scarcely longer than the metacarpal bone of its forefinger. In the bat, the pieces of the fingers are seen to be very long and delicate for the membrane to be stretched on, which enables them to serve for wings. In the fish they are numerous, and placed close together, to form a fin. In the frog, for the same reason, they are webbed. In the bird they are few and short, while the metacarpal bones are long, to give support to the large feathers of the wing. In the quadrupeds with claws they are all placed side by side; and those who have hoofs, as the deer, cow, and horse, have but one or two, according as the hoof is single or divided, placed nearly perpendicular, and walk, as it were, on the points of their toes and fingers, the part of the hoof which rests on the ground corresponding to the edge of the nail. The distinctions between hand and foot, the argument as to monkeys, &c., having hands or feet as their hinder extremities, and the discussion as to hands and feet having originated from one typical common form of extremity, are all fully considered in the article FOOT.

Turning from the bony structure to the muscular connections of the hand we refer again to the Plates of ARM (Arm, Shoulder, and Hand), where, in Plate I. fig. 16, at *c c*, we see the four *lumbricales* or worm-like muscles (like earthworms in shape, whence their name) which originate in the palm and are inserted into the outer side of the first digital bones, which they bend and also incline outwards, that is, away from the thumb. In Plate II. fig. 21, we see the great flexor of the wrist (*n*) arising from the inner cordyle of the upper arm, bending the hand forwards and inwards, and assisting in pronation. Pronation means palm inwards

or downwards, supination means palm outwards or upwards, and both of these movements are treated of in the article ARM. The other flexor is shown at *o*. The extending muscles of the hand are three, their office being to bring the hand straight in line with the arm; they are shown at *p q r* in fig. 22. In fig. 23, *a* and *b* are the two *pronator* muscles proper, turning the hand by means of the radius bone upon which they act. They are antagonized by the *supinators*, fig. 22, *a b*, which, besides their office of supination, assist also to extend the hand upon the forearm. There are two long flexors of the fingers, bending them upon the palm. The perforated or superficial flexor is shown in fig. 21, *a*; it divides into four muscular bellies ending in as many tendons about the middle of the forearm; these tendons split in two at their extremity, and are inserted in the second of the three digital bones. Through the fork thus made pass the four tendons of the deep or perforating flexor (also divided into four branches like its colleague), and these latter tendons are inserted into the finger tips. The deep flexor is shown in fig. 20, *b*. There is one long flexor of the thumb, fig. 20, *d*, and one short flexor also, fig. 21, *e*, the former arising from the top of the forearm, the latter from the wrist bones; their function is to bend the thumb upon the palm. These are antagonized by the three extensors of the thumb, fig. 22, *g h i*, each with its own special direction and insertion. The thumb has also an *abductor*, fig. 20, *j*, on the outside of the ball, carrying it outwards and forwards from the palm; a small flexor, shown at *k* in fig. 16, lying beneath the abductor; and an *adductor*, the antagonist of these two, bringing the thumb inwards and backwards to the palm—an important muscle, shown at *k*, figs. 17 and 21. The abductor and adductor of the little finger are seen in fig. 16, *l m*. The fingers are extended (straightened) by the great common extensor, fig. 22, *f*, which, like the flexors it antagonizes, divides into four bellies, with as many tendons. It is not nearly so powerful a muscle as the flexors. The first finger has also a special extensor of its own.

HAND-BELL RINGING, or *Campanology*, as it is sometimes ridiculously called by the unlearned professors of the art, is a species of musical performance upon a detached CARILLON or set of bells, on a small scale, so as to be portable. Three or four such bells can be held in each hand, by leather straps passing between the fingers, and a few men can therefore easily ring any tunes desired, with fitting accompanying harmonies. The difficulty is of course to fit in at the proper point in the intricate mosaic work of the music, since each bell has but one note. The effect is pleasing in the open air, and audible at a considerable distance. The tinkling of sheep-bells which happen to be in tune is an humble instance of the pretty effect obtainable. Skilled hand-bell ringers frequently amuse themselves and others with a comic performance, when bells are fixed to the head, the feet, the elbows, &c., and the requisite contortions to ring them in their proper places are never-failing provocatives of laughter.

Hand-bells serve also for preliminary practice for church-bell ringers who desire to study the proper changes. See BELL.

HAN'DEL, GEORGE FREDERICK, one of the greatest of musical composers and musicians, was born at Halle, in the duchy of Magdeburg, Lower Saxony, on the 23rd of February, 1685, and died in London at 57 (now 25) Brook Street, Hanover Square, on the 14th of April, 1759. This date of his birth (differing from that given in the inscription on his monument in Westminster Abbey) is proved by the baptismal register preserved in the Marienkirche in Halle. His name was, accurately speaking, *Georg Friedrich Händel*, and at first he was called *Signor Hendel* in England, *Signor* as being known only for an Italian opera writer, *Hendel* as nearer the true pronunciation of his name than *Handel*. The composer himself, however, later spelt his name with *a*, not *ä*, and in other ways than this endeavoured to naturalize himself among the people of his choice. The father of Handel was a surgeon by profession, and son of a coppersmith, who was a burgher of credit. When the musician was born the surgeon was already sixty-three years old. He designed the child of his old age for the study of the law, and peremptorily forbade the practice of music, for which the child showed a passionate fondness. The boy contrived to elude the parental interdict, procured a clavichord, which he muffled and secreted in a garret, and passed many a stolen hour in practising upon it. A half-brother of Handel, a son of his father's first marriage, was valet to the Duke of Saxe-Weissenfels. When little George was seven years old he accompanied his father on a visit to this relation. Arrived at the palace young Handel made friends with the organist, and soon found an opportunity, after service in the chapel, to enter the organ gallery, and there to place his tiny fingers on the keys. The duke heard him play, and straightway advised the father to take means for developing the rare genius manifested by his son. The elder Handel yielded, and Zachau, the organist of the cathedral at Halle, was the man judiciously selected to be Handel's instructor. While sedulously pursuing the study of composition Handel continued to practise the harpsichord, and he likewise received lessons upon the organ; at the same time he worked diligently at the violin, and played also upon the oboe, which was the instrument of his particular preference at this period. When Handel was eleven years of age the teacher acknowledged that he had learned all that it was in his power to teach him, and recommended his being sent to Berlin. Here Handel quickly made his talent known, and was generally and justly regarded as a prodigy. The Elector of Brandenburg (who soon after, in 1701, became the first king of Prussia) was so delighted with young Handel's remarkable skill that he made proposals to attach him to the court, and offered to send him to Italy to complete his musical education. The father, however, opposed this project, and ordered his son to return to Halle. With unabated diligence Handel again placed himself under the discipline of Zachau. The old surgeon died shortly after his son's return from Berlin, leaving him dependent on his talents, which about this time had procured him the situation of organist in one of the churches in Halle. Anxious for a wider field of action than this small town afforded him, Handel in 1703 set off for Hamburg. In that city there was a well-appointed German opera under the direction of Keiser, in the orchestra of which he obtained an engagement as second violin, and on Keiser's departure (to hide from his creditors) succeeded to his post at the harpsichord. In 1704 Handel composed his first important work of which any record is found—this was a "Passion," a cantata to be performed on Good Friday. The composer Mattheson, who is remembered now only by his writings on music, was at Hamburg, and very friendly with Handel. His anecdotes are of course priceless. Some are amusing, as for instance when the two friends compete for the great organ at Lübeck, but hurriedly both retire from the contest when it is explained that the victor is expected to marry the daughter of the former organist. At the end of 1704 he had a quarrel with Mattheson respecting the leadership of the orchestra in that composer's opera of "Cleopatra." Mattheson sang "Antony," and after his death-scene preferred to come forward and conduct. This Handel considered (with reason) inartistic. It ended in a duel, that might have had a fatal result but for the breaking of Mattheson's sword, when some friends parted the combatants. On the 8th of January, 1705, Handel produced his first dramatic work, the German opera of "Almira." The success of this was such as to warrant the production,

before the end of the following month, of "Nero," a second essay in the same form. Two other operas, "Daphne" and "Florinda," also produced by Handel at the German theatre, appeared, as it would seem, in 1706. Gaston de' Medici, brother of the Duke of Tuscany, invited the rising composer to accompany him to Italy. Handel had amassed in Hamburg the sum of 200 ducats, and with this little fortune he set out accordingly in the summer of 1706, and went directly to Florence, where he arrived in July. He rewrote "Florinda" under the title of "Rodrigo" for Florence. At Easter he went to Rome. Immediately he arrived he wrote a Dixit Dominus; a Laudate soon after; a Magnificat for double choir and orchestra, and several other pieces of the same class while he remained there; and also the two oratorios, "Il Trionfo del Tempo e del Disinganno" and "La Resurrezione;" but though he composed in Rome an opera called "Silla," it was never performed. He was the guest of the Marquis de Ruspoli, and the courted companion of the greatest personages of the city. In July, 1708, Handel was in Naples, and busied himself with composition immediately on his arrival. He wrote in this city the serenata of "Aci, Galatea e Polifemo"—an entirely different work from that upon the same subject with English words which he produced eleven years later. During the carnival of 1709 he went to Venice. There he wrote the opera of "Agrippina," which excited a furore among the Venetians. On the death of his sister in the autumn of 1709 he returned to Germany and went to Hanover, where the Elector George (four years later to become King of England) welcomed him, and appointed him *kapellmeister*, with a salary of 1500 crowns.

In the autumn of 1710 Handel set out for England in response to pressing invitations. He was delayed some time at Düsseldorf by the elector-palatine, who paid the highest honours to his genius. Thence he proceeded to Halle to visit his mother, who had become blind. After passing through Holland the illustrious musician first set his foot in this country, the land of his future adoption, towards the close of 1710. He scarcely had arrived when he was engaged to compose a work for the Italian opera then established in London. "Rinaldo," the work that initiated the fame of its immortal composer in England, was produced on the 24th of February, 1711, at the King's Theatre in the Haymarket. It had been entirely composed in a fortnight. Its reception surpassed the most sanguine expectations. Two pieces from "Rinaldo" are familiar at the present time; these are the beautiful air "Lascia ch'io pianga" and the march. The sale of this opera was so enormous that Walsh, who published it, made thereby a profit of £1500. The termination of Handel's leave compelled him to return to his engagement at Hanover. He was admitted to an audience of Queen Anne to take leave of her, and she dismissed him only after he had promised to revisit this country. On his way back to Hanover he again rested at Halle to spend some time with his mother. Handel grew quickly impatient of the quietude of the little German court, and yearned for the activity and the triumphs of London. He sought permission again to leave the duties of his office, and arrived here in 1712—so early as to compose his ode for Queen Anne's birthday for performance on that occasion, the 6th of February. In the November following he produced the opera of "Il Pastor Fido;" and in January, 1713, that of "Teseo."

The peace of Utrecht was concluded 11th April, 1713, and it was appointed that a public thanksgiving should take place in St. Paul's Cathedral on the 7th of July; to give special effect to which Handel, by command of Queen Anne, was engaged to compose a Te Deum and Jubilate. The admiration these works excited was so general that the queen made them the occasion of granting their composer a pension from the privy purse of £200 per annum. Anne died August, 1714, and the Elector of Hanover succeeded to the throne as King George I. He was, and well might be, offended with Handel for deserting his court and the liberal appointment he had given him there. Handel, who on his side was afraid to meet the angry king, accepted an invitation of the Earl of Burlington, and he was retained as a guest by this nobleman until he next quitted England. Under his roof he wrote "Amadigi," incorporating portions of the unproduced Roman opera of "Silla;" and this was performed with singular magnificence in May, 1715. On the 22nd of August the king held a public festival on the Thames, and the Baroness Kielmansegge made this an occasion to reconcile him with Handel, who by her advice wrote the twenty-five pieces since celebrated as the Water Music. The admiring monarch restored the pension of £200, with the pardon of his truancy from Hanover. The next notice of Handel occurs in June, 1716, when he gave a performance at the opera "for the benefit of the musicians," this being the first occasion in which his kingly munificence to his fellow-artists is signalized. It seems probable that he went in the July of this year, in the retinue of George I., to Hanover. It must have been while in Hanover that he wrote the German oratorio of "Die Passion," and this he sent to his old antagonist Mattheson for performance at Hamburg on Good Friday, 1717. Handel took advantage of being in Germany again to visit his blind and now aged mother. Hearing of his being at Halle, J. Sebastian Bach, who was then at Kothen, felt so eager a desire to meet his illustrious fellow-artist, that he walked the intervening distance of 16 miles on purpose to see him: but he arrived in Halle on the very day that Handel had departed. The two masters therefore never met. Handel also passed through Anspach, and there encountered his old friend Schmidt, who came back with the musician to England, and from the time of his arrival officiated as his treasurer, undertaking the entire financial arrangements of his public performances, and controlling all the business details of his affairs.

Handel was engaged in 1718 by the Duke of Chandos as "master of the chapel," the single instance of this title being applied to a musician in England; and he resided, in the fulfilment of the office, for three years or longer at Cannons, the seat of the duke at Stanmore, near Edgeware. Twelve anthems and two Te Deums, all with orchestral accompaniments, are referred to this period. When Handel was first engaged Pepusch was still "master of the chapel," but he almost at once retired in favour of the more gifted younger composer. Herr Handel had the inestimable advantage of an orchestra of his own, ready to perform anything he wrote for it.

A society calling itself the Royal Academy of Music was formed in April, 1720, and before the end of the month a new opera of Handel's was produced. This was "Radamisto," the production of which was attended with the most extraordinary excitement. His next work was his first English oratorio, "Esther," which was originally performed at Cannons on the 22nd of August, 1720, and for which the duke is reported to have paid the composer £1000. Handel at this time was giving periodical lessons to the daughters of the Prince of Wales (afterwards George II.) He composed for Princess Anne his first collection of "Suites de Pièces," in one of which is the air, with variations, now known by the name of the "Harmonious Blacksmith," which owes this title to Lintot, a musicseller of Bath about sixty years ago, who had been a blacksmith. The first piece he printed was this air, with variations, detached from the "Suite," to which it belongs; and to bear testimony to his own origin, he bestowed on the piece the name which has been elaborately traced to a different source. The English serenata of "Acis and Galatea" was originally performed at Cannons in 1721.

The grand feature of the next season of the Academy

was the opera of "Muzio Scevola," which concentrated the powers of Ariosti, Bononcini, and Handel. The two former had just been invited to England. Ariosti wrote the first act, Bononcini the second, and Handel the third, so that the relative merits of the three were brought into immediate comparison. Chrysander ("Life of Handel") says it was not Ariosti but Mattei who wrote the first act. Handel emerged absolutely triumphant from the contest. [See BONONCINI.] Handel's next work, "Floridante," which was brought out in December, was the production of the Academy's third subscription series. The opera of "Ottone" was produced in January, 1723, and "Giulio Cesare" and "Flavio" followed it in the same year. "Tamerlano" was Handel's sole production in 1724, and in 1725 he gave his "Rodelinda" to the public.

In 1725 Handel took the house in Brook Street which was his residence for the rest of his life. The course of Handel's Italian opera successes, in spite of the violent party feeling of the Bononcini faction, continued its triumphant way in 1726, when "Scipione"—notable for its much-admired march—and "Alessandro" were both produced. On the 20th February of the same year the Act for naturalizing the illustrious musician in England received the royal assent. "Admeto" and "Ricardo Primo" were given in 1727. A series of works of higher artistic purport than anything which he had produced since "Acis and Galatea," and of far more enduring interest, makes this year, 1727, an important one in Handel's career. The four anthems composed for the coronation of George II. and Queen Caroline are in the grandest style of their author, eminently appropriate to the splendid solemnity for which they were designed. "Siroe" and "Tolemeo," two more Italian operas of Handel, were brought out in the last disastrous season for the Royal Academy of Music, 1728. Handel had accumulated a sum of £10,000, and was in the annual receipt of £600. On the dissolution of the Academy he determined to risk his capital and his energies in a partnership with Heidegger, the proprietor of the King's Theatre. Preparatory to the new campaign, he went to Italy to engage a new company; and after visiting his mother at Halle, returned to England by way of Hamburg in June. He opened his eventful managerial career on the 2nd of December with the opera he wrote for the occasion, "Lotario." "Partenope" was first performed, as "Rinaldo" had been, on the 24th of February, 1730, the anniversary of his baptism. Handel's only production in 1731 was the opera of "Poro;" but he began the next year with greater activity, for he brought out "Ezio" in January, and "Sosarme" three weeks afterwards.

An incident now occurred which materially affected the nature of the performances at Handel's theatre, and which influenced in an important manner the subsequent direction of his genius. This was the public production of "Esther," the first oratorio ever performed in England. The interest excited by "Esther" induced the public production of the other still greater work, written by Handel for the Duke of Chandos, "Acis and Galatea."

In November, 1732, the opera of "Orlando" was written for production in the coming season. The second English oratorio, "Deborah," was completed on the date most conspicuous in Handel's history, the 24th of February. Although Handel enjoyed the king's favour, he had by this time many enemies among the nobility. A quarrel which he had with Senesino the singer brought his "fashionable" unpopularity to the point of culmination. His chief subscribers threw up their boxes before the close of the season, and announced the opening of a rival opera, with Senesino for its chief attraction in the ensuing year. The third oratorio, "Athalia," was written in the very heat of Handel's managerial perplexities, and it was first performed at the Oxford commemoration in July, 1733. Handel paid a hurried visit to Italy in company with his treasurer, whose name was now Anglicized into Smith, to make engagements for his coming season. Immediately he returned he wrote the opera "Ariana," which was not, however, performed till four months later, in January, 1734. The rival establishment to the King's Theatre was opened in December, 1733, at the theatre at Lincoln's Inn Fields, under the patronage of the Prince of Wales and several nobles. The season opened with Porpora's "Ariana," forestalling thus the subject of Handel's forthcoming work, and so giving the utmost appearance of hostility to the opposition. The wedding festivities of the Princess Anne, Handel's pupil, in March, 1734, called his powers into requisition. He furnished an anthem for the ceremony at the chapel royal, and "Parnasso in Festa," an epithalamic serenata, was performed at the opera on the following evening. The season of 1734 terminated Handel's partnership with Heidegger, who then accepted the directors of the rival opera as tenants. To be beforehand with his adversaries Handel began his season of sole responsibility at the Lincoln's Inn Theatre in October; but this was only a temporary arrangement while the building of Covent Garden Theatre was being completed; and he opened the new establishment by royal command in November. At the beginning of 1735 Handel produced "Ariodante." He now lighted on a scheme for meeting the pious scruples which had led the production of his oratorios to be censured as profanity. This was to devote the evenings of Wednesday and Friday during Lent to their performance; and he began this first series of that class of entertainments with the introduction of the oratorio of "Athalia" to the London public. Returning to his secular performances after Easter, he produced the opera of "Alcina." He composed within three weeks Dryden's "Alexander's Feast." The work was produced in January, 1736, and it was crowned with a success greater than any of the foregoing works of Handel. He had now to write an anthem for the marriage of the Prince of Wales, and pertinent to the same festivity was the production of his opera of "Atalanta" in May. In January, 1737, Handel produced "Armenio," which was followed by "Giustino" in February. After Easter he produced "Berenice," and the failure of this work terminated an unsuccessful season. The excitement to the fashionable world of the opposition operas had waned away. The noble directors, Handel's rivals, had squandered £12,000, and their single opponent had, besides expending his £10,000, incurred heavy liabilities which he was obliged to procure license of time to discharge. Handel's health had for some time greatly failed him, and he was now seized with a fit of paralysis. When sufficiently recovered from this he went to Aix-la-Chapelle for the benefit of the waters, the good effect of which upon him was marvellous. On his return to London he engaged immediately in the composition of his "Faramondo." While he was employed upon this score the queen died. The work was set aside, therefore, that he might write an anthem for the royal funeral; and this magnificent composition was performed at the obsequies of Queen Caroline on the evening of the tenth day after that on which Handel received the commission for its production. Reverting to his former task, he finished "Faramondo" on the 24th of December, rested from his labours for the Feast of the Nativity, and began "Serse" on the 26th. On the 19th of April, 1738, was established the Society for the Relief of Distressed Musicians, the title of which has since been modified into the Royal Society of Musicians. In several successive donations, and in his bequest of £1000, Handel was an enormous benefactor to the society. Handel wrote several minor pieces expressly for public gardens. Tyers, the proprietor of Vauxhall, engaged Roubilliac to make, for erection in the gardens, the full-length marble statue of the composer that is now in the possession of the Sacred Harmonic Society. The inauguration of this statue

took place on the 1st of May, 1738, when the music for the evening was selected entirely from Handel's compositions.

This year, 1738, is rendered especially memorable in Handel's artistic life by the composition of the oratorio of "Saul," and also of his mighty masterpiece, "Israel in Egypt." "Saul," which is universally known by its dead march for the obsequies of the king, was produced at the King's Theatre, 16th January, 1739. On the fourth day after the completion of "Saul," 1st October, 1738, Handel commenced "Israel in Egypt." It was first performed at the King's Theatre, 4th April, 1739.

Handel's next important production was the "Ode for St. Cecilia's Day," set to the first of Dryden's two poems for that occasion; this was performed on the 22nd of November at the theatre in Lincoln's Inn Fields, together with his setting of the other ode, "Alexander's Feast." It was now that he produced the music to Milton's "L'Allegro" and "Il Penseroso," together with a third part, added by Charles Jennens, and called "Il Moderato." This he composed in fifteen days. The season of 1740–41 was the last in which Handel had any concern, either as a manager or a composer, in Italian opera. He took the theatre in Lincoln's Inn Fields, and produced there, besides many revivals, two new operas, "Imeneo" and "Deidamia." The undertaking was a total failure.

Handel was now invited to Dublin by the Duke of Devonshire, then viceroy of Ireland. Preparatory to his visit he wrote the oratorio of "Messiah." On the 18th of November Handel arrived in the Irish metropolis, where the cordial welcome he received was such as to compensate him for all his London vexations. The contrast gave Pope his fine lines in the "Dunciad" where the goddess Dulness is addressed thus:—

"Strong in new arms, lo, giant Handel stands
Like bold Briareus with a hundred hands;
To stir, to rouse, to strike the soul he comes,
And Jove's own thunders follow Mars' drums.
Arrest him, Empress! or you sleep no more!—
She heard, and drove him to th' Hibernian shore."

He gave his first performance of a series of six on the 23rd of December, which consisted of "L'Allegro" and other instrumental pieces. His complete success induced the announcement of a second series. "Messiah" was first performed for a charitable benefit on the 13th of April, 1742—a day for ever signalized in the history of music. The success of the work was complete, and its repetition on the occasion of Handel's farewell in August was not less attractive than its original performance. "Messiah" was given in London first on the 23rd of March, 1743, when its title was suppressed, and it was announced as "A new Sacred Oratorio." The "Sacred Oratorio" was unsuccessful in London, and was this year but once repeated. In the following year it was not played, but in 1745 it was again twice given. It was then laid aside for five years, to be reproduced with its original name on the 11th of April, 1750, when its reception was such as to fix it eternally in men's admiration. On the 1st of May following Handel gave a performance of this work in the chapel of the Foundling Hospital for the benefit of the charity, when he opened the organ which he presented to the institution.

In 1743 Handel took Covent Garden Theatre for a series of subscription performances. These were opened with "Samson," which had considerable success. Handel had drawn new youth from the true Irish warmth of his Dublin reception, and began this season to trust alone to his English claims on English sympathy, composing only to English words. From this year until that of his death he gave annually his performances during Lent. In June, 1743, he wrote "Semele," and in August "Joseph and his Brethren," both of which were produced at Covent Garden during the ensuing Lent. Between the composition of these two works, the great "Te Deum" was written for the victory of Dettingen, which was performed at the chapel royal on the 27th of November. In the early autumn of 1741, the time of year at which his imagination was generally the most fruitful, Handel wrote "Hercules." Immediately afterwards he composed the oratorio of "Belshazzar." The success of both was indifferent. Handel had announced a series of twenty-four subscription performances, extending through the winter of 1744–45, at the King's Theatre, but they were so ill attended that he was compelled to close the series on the sixteenth night. This failure more than exhausted the profits of Handel's visit to Ireland, obliging him a second time to suspend his payments, and to obtain license from his creditors. At the beginning of 1746 the "Occasional Oratorio" was put together for a series of performances at Covent Garden. The final victory of Culloden was a national event for Handel to celebrate, and he chose the subject of "Judas Maccabeus" for the purpose. This oratorio was composed between the 9th of July and the 11th of August, 1746, and performed on the 1st of April following. The noble chorus, "See the conquering hero comes," which now forms a part of this oratorio, was introduced into it two years after its first performance—the chorus having been written for "Joshua," which was brought out in the interim. Between the beginning of June and the end of August, 1747, the oratorios of "Alexander Balus" and "Joshua," were both composed; and these were performed in the course of the following Lent. In May and June of the next year, Handel wrote "Solomon;" and in July and August "Susannah." The two oratorios were performed in the Lent of 1749. Two compositions were the produce of the summer of 1749—"Alcestis," an English opera, and the oratorio of "Theodora."

Handel had now amassed a third fortune. The infirmities of age were advancing upon him; worst of all of which was the failure of sight. He resolved on visiting his native country once more before his death, and preparatory to this journey he made his will. At some time prior he had presented Smith, his treasurer, with £1000; and now he inserted his name in his testament for a legacy of £500, with the additional bequest of the harpsichord and organ on which he used to play, and of the original manuscripts of his works. Before the end of the month Handel wrote in a single week the interlude of the "Choice of Hercules," incorporating several pieces from "Alcestis." On his way back to London, between Haarlem and the Hague, he had a fall, from which he experienced some temporary injury. The year 1751 is rendered peculiarly interesting by the composition of "Jephtha," the last work Handel wrote with his own hand. "Jephtha" was produced in 1752, and in this year Handel succeeded to his mother's heritage of total blindness. He now amused his hours of helpless idleness with dreams of his earthly immortality; and this he thought he would best secure by depositing his MSS. in the Bodleian Library at Oxford. He therefore requested the elder Smith to forego the bequest which he had made him of these, and offered him as an indemnification £3000. This equivalent was refused, and the composer, touched by so genuine a proof of his friend's devotion, made a codicil to his will in August, 1756, in which he inserted an additional legacy of £1500 to his stanch admirer. It must have been after this interchange of generosity that the two friends went together to Tunbridge, and there had a violent quarrel. So violent was it, and so implacable was Handel's resentment, that no appeal of Smith's could bring him to a reconciliation. For the oratorio season of 1757, Handel remodelled his Roman work, "Il Trionfo," in the English "Triumph of Time and Truth." The younger Smith officiated as his amanuensis, writing down this work from his dictation. In the following year Smith's services were again exercised in noting down the song, "Wise men

flattering," and the duet and chorus, "Sion now her head," for introduction in "Judas Maccabeus"—the latter of which is said to be the very last composition of Handel. Towards the end of March, 1759, Handel and his old friend Smith, by means of the son, were finally reconciled. A fortnight after this, on the 6th of April, "Messiah" was given as the final performance of the season, Handel presiding as usual at the organ. It was Handel's earnest desire that he might die on Good Friday, hoping thus that he might rise again at Easter to meet his Redeemer. The desire was practically accomplished; for on Saturday the 14th April, 1759, the great musician breathed his last.

Handel had requested that he might be buried in Westminster Abbey, and that he might have a monument erected there to his memory, bequeathing the sum of £600 to defray its cost. His funeral accordingly took place there on the 24th of April, and it was attended by a concourse of 3000 persons. The monument, which stands over his grave in Poet's Corner, was the last work in England—as that of the composer sculptured for Vauxhall was the first—which Roubilliac executed. In 1784, which was supposed to be the centenary of the musician's birth, George III. commanded the famous commemoration of Handel in Westminster Abbey, and the immense interest it excited induced several annual repetitions of this homage to the master's memory. In 1859—the centenary of the musician's death—another and by far the most magnificent commemoration of Handel took place at the Crystal Palace, which was preceded by an experimental festival in 1857. The delight of the public was so unequivocal that these *Handel Festivals* have since been continued triennially on the same magnificent scale, perhaps the finest of them all being that of 1883. [See FESTIVALS, MUSICAL.] The original MSS. of nearly the whole of Handel's works were bequeathed by him to the elder Smith, who left them to his son, and he presented them to George III., from whom they have descended to Queen Victoria, and are now preserved in Buckingham Palace. The original MS. of the Messiah has been published in facsimile, and is of absorbing interest to a musician.

It is happily superfluous to enter upon the consideration of the sublime compositions of Handel. They are (the oratorios) the property of every Englishman, and few indeed are not well acquainted with the chief of them. To meet the great demand the publishers vie with each other in bringing out editions of these at merely nominal prices. His other works (Italian operas, composed to suit the fleeting taste of the time) have now gone by, except a few songs and other fragments. Some of the harpsichord pieces and some sonatas for the violin still keep the stage in the concert-room. But Handel's fame rests on his English oratorios; and these are more than enough to immortalize him. They have never been approached, nor even successfully imitated. They contain, moreover, all his best previous work, for it was Handel's custom to use for his oratorios pieces from his instrumental work or his own Italian operas. One of the best known instances is "The Lord is a man of war," the famous duet for two basses. We need not agree with Berlioz, the eminent French musician, in his condemnation of this use of his own old materials as an artistic heresy of the deepest dye; but we all must join in passing an adverse verdict upon Handel when he descends to pilfer from other composers. It is to be feared that Handel had not the excuse of Coleridge, who would write pages of Schelling without really knowing that they were not his own, so weak and yet at the same time so accurate was his memory, a living paradox. We find, for example, an organ piece by Kerl exactly transcribed, with the mere change of key from D minor to E minor, and with words set to it, forming the chorus "Egypt was glad" in "Israel in Egypt." Stradella wrote a trio with orchestral accompaniment, and from this large slices have been cut by Handel for "Israel" and other works. The worst case is a Te Deum by Urio, whence Handel has drawn fifteen movements! Nine movements of the Dettingen Te Deum, and six of "Saul" are in fact not Handel's but Urio's to all intents and purposes. Many single themes and *motivi* are traced to other authors. If we contrast him with the virtuous Bach in this particular his memory must bear a great stain. It is not agreeable to touch on this feature in Handel's career, but it is certainly inexcusable, on the other hand, to exaggerate it, as many have done. For instance there is much of his later work drawn from a certain "Magnificat," the MS. of which bears on its face the title "del Rev. Signor Erba." But surely this might mean "belonging to the Rev. Mr. Erba;" in fact grammatically it should mean this, *dal* (and not *del*) being the proper Italian word for "of" in the sense of "written by:" and we find, too, that the music is written on English paper, &c. Yet some writers speak as if it were positively known not to be Handel's work. It appears fairer to give the benefit of the doubt. In other things we find Handel emphatically a good man, and it seems just to set down this curious want of honesty in artistic matters to a pretty general carelessness about it current at that time. Sometimes a writer was severely punished when caught [see BONONCINI]; sometimes, as Handel, he was encouraged. It is pleasant rather to contemplate Handel's cheery good humour, his right royal munificence, his unaffected piety, his unflagging industry, his integrity, and his manly independence. As to this last point, when the ladies of the court talked during music he would peremptorily silence them; but his temper was as easily appeased as roused. Besides the two statues by Roubilliac already mentioned as from life, and one from a mask taken from the face after death (the Westminster Abbey one), there are several good portraits of Handel. The best is one said to be by Hogarth, and admitted as such by the art-critic Ruskin; it was exhibited at the Handel Festival of 1883 at the Crystal Palace. All these show him as a somewhat heavy unwieldy man, but with a kindly expression. Dr. Burney, the musical historian, an intimate friend of his, says "his smile was like heaven."

The great work on Handel's life is the "G. F. Haendel' of Dr. Chrysander (Leipzig, 1858 to 1867), in German—heavy, voluminous, and scarcely readable; but the grand Leipzig edition of Handel's entire compositions makes it seem ungrateful to speak harshly of such a true enthusiast. A rather overwrought biography, by Rockstro, appeared in London in 1883, and an excellent but short account of the composer by Mrs. Julian Marshall was published the same year in "The Great Musicians" series of biographies. It is not too much to say therefore that Handel still needs a biographer, some one who will present the learning of Chrysander in an assimilable form. As an interesting sign of the growth in France of appreciation of the works of Handel, it may be mentioned that the first biography of the great master which has appeared in the French language, was published in Paris, in 1884, by M. Ernest David. The title of the work is "G. F. Handel: sa Vie, ses Travaux, et son Temps."

HANDEL FESTIVALS. See FESTIVALS, MUSICAL.

HAND-GLASS is a name given by gardeners to a portable glazed cover which they place over certain plants for one of two purposes, either to screen them from the effects of cold and wet without depriving them of much light, or to maintain around them an atmosphere of uniform humidity. Bell-glasses differ from hand-glasses in no respect with regard to the purpose they are intended to serve, but are blown from a single piece of glass instead of being composed of many pieces fastened together. Glasses of this description are principally used to assist cuttings of plants in the process of striking root, or newly-planted individuals in establishing themselves in the soil.

HAND-TREE. See CHEIROSTEMON.

HAND'ICAPPING is a term used in sports and games when it is intended to place all the competitors on the same level. Thus in horse-racing, in which the plan is pursued more than in anything else, when a horse has proved itself to be very swift, or has advantage over its antagonists in point of age, it is in many races "handicapped," *i.e.* made to carry extra weight to such an amount as may be deemed sufficient to counterbalance its advantages. In yachting, the yachts start together, but the large ones have to allow the smaller ones a handicap of so much time, and thus, although one of the former may arrive first, it does not necessarily follow that it is the winner. The derivation is from *hand i' cap*, a method of drawing lots.

HANDS, IMPOSITION OF, a form employed in many ancient and modern religious ceremonies, symbolical of the conferring of certain spiritual gifts. The laying on of hands is mentioned in the earliest portions of Scripture, and Christ adopted the same rite when blessing little children. The apostles ordained ministers to their churches by the same ceremony. The usage still remains in the Roman Catholic, Anglican, and Lutheran churches in the ordination of ministers and in confirmation, and in the former ceremony it is retained by the Presbyterians.

HAND'SEL is the first act of anything. The word is used popularly to signify a first transaction in trade, the money taken for the first sale, the first instalment paid on a debt, or the first business done on any day or week. The first Monday in the year is called Handsel-Monday, and a gift made on that day a handsel. The word is more commonly used in Scotland than elsewhere.

HANGING, the principal mode of execution in the United Kingdom since the year 1240. It is only in the cases of treason and murder that capital punishment is now carried out. Hanging is considered the most humane way of executing a sentence of death, as it is as nearly instantaneous as possible. Formerly it was always done in public, but since 1868 all executions have taken place within the prison walls. In order to prevent any miscarriage of the law the execution must be witnessed by the sheriff, the gaoler, the chaplain, surgeon, and other officers; and after death an inquest is held on the body to ascertain its identity, and whether the execution was duly performed. In the army and navy a condemned prisoner is usually shot, but sometimes hanged, which is considered a more disgraceful mode of execution. In France convicts are decapitated by the GUILLOTINE, in Germany they are beheaded, and in Spain garotted. See CAPITAL PUNISHMENT.

HANGING GARDENS, a term commonly applied to the celebrated gardens of Babylon, which are frequently mentioned in ancient history, and fully described by Herodotus, Diodorus, and other Greek writers. So magnificent and extensive was their structure that they have been classed among the seven wonders of the world. It is related that they occupied a square of 400 feet on every side; and the different terraces were carried upwards one above another, until the height equalled that of the walls of the city. This prodigious work was begun by Nabopalassar and completed by Nebuchadnezzar for the gratification of his favourite wife Amytis. The whole was sustained by stupendous arches, and the soil laid upon them was sufficiently deep to enable the largest tree to take root therein.

HANKOW', one of the treaty ports of China, in lat. 30° 30′ N. and lon. 114° E., is situated inland, 600 miles up the Yang-tze-kiang River. It is of great extent, in reality consisting of several cities and towns, and has a population of about 400,000. The native town, situated on the junction of the Han with the Yang-tze-kiang, is long and narrow. In addition to that within the town there is also a large floating population on the Han. A British settlement was made on the eastern side in 1864, and there are now a considerable number of foreign business firms, a foreign inspectorship of customs, and English and American consulates. The town has manufactures of ribbons, velvets, and felt, and coal abounds in the neighbourhood. Hankow is the chief mart of the tea districts in the interior, and carries on a large trade with Shanghai; cargoes are also sent direct to England from this port. The annual value of exports and imports is each about £6,000,000. The chief article of export is tea, of which about 75,000,000 lbs. are shipped annually, chiefly to England. The other articles of export are silk, wood, safflower, and tobacco. The imports consist chiefly of cotton shirtings, opium, sandal-wood, and lead.

HAN'LEY, a town and municipal borough of England, in the county of Stafford, on the North-western Railway, 2 miles S.E. of Stoke-upon-Trent, and 147 miles N.N.W. of London, is in the centre of the Potteries, and since 1885 returns one member to the House of Commons. The town is well paved and the suburbs contain many good houses, though the population is confined chiefly to the working classes. There are several churches and chapels, and an excellent school of art. The town also contains a large town-hall, museum, mechanics' institute, exchange, theatre, &c. The inhabitants are chiefly engaged in the manufacture of china and earthenware. Near the town are some iron and coal pits. A charter of incorporation was granted to Hanley in 1857. The population within the limits of the municipal borough (including part of the township of Shelton) numbered 48,354 in 1881.

HAN'NIBAL, the son of Hamilcar Barca, was born B.C. 247. At the age of nine he went to Spain with his father, who previous to his departure made him swear that he would never be a friend to the Romans. He was at a very early age associated with his brother-in-law Hasdrubal, who succeeded Hamilcar in the command of the Carthaginian army in that country. On the death of Hasdrubal, 221, he obtained the undivided command of the army, and quickly conquered many of the Spanish tribes. The inhabitants of Saguntum, alarmed at his success, sent messengers to Rome to inform the Romans of their danger. A Roman embassy was accordingly sent to Hannibal, who was passing the winter at New Carthage (now Carthagena), to announce to him that the independence of Saguntum was guaranteed by a treaty between the Carthaginians and Romans (concluded 226), and that they should consider any injury done to the Saguntines as a declaration of war against themselves. Hannibal paid no regard to this remonstrance.

In 219 Hannibal took Saguntum, and employed the winter in making preparations for the invasion of Italy and providing for the security of Africa and Spain. He set out from New Carthage in the spring of 218, with 80,000 foot and 12,000 horse. Before crossing the Pyrenees he left Hanno to secure his recent conquests with a detachment from his own army of 11,000 men. He sent back the same number of Spanish troops to their own cities, and with an army now reduced to 50,000 foot and 9000 horse he advanced to the Rhone. Two Roman armies had been levied; one, commanded by the Consul P. Cornelius Scipio, was intended to oppose Hannibal in Spain, and a second, under the other consul, T. Sempronius, was designed for the invasion of Africa. The departure of Scipio was delayed by a revolt of the Boian and Insubrian Gauls, against whom the army was sent which had been intended for the invasion of Spain, under the command of one of the prætors. Scipio raised a new army, sailed to the Rhone, and anchored in the eastern mouth of the river. But Hannibal had already crossed the Rhone, and Scipio did not arrive at the place where the Carthaginians had passed the river till three days afterwards. Upon this he sailed back to Italy with the intention of meeting Hannibal when he should descend from the Alps. Scipio sent his brother Cnæus into Spain, with the greater part of the troops, to oppose Hasdrubal, Hannibal's brother.

Hannibal continued his march up the Rhone till he came to the Isère. Marching along that river he crossed the Alps (probably by the Little St. Bernard), descended into the valley of the Dora Baltea, and followed the course of the river till he arrived in the territories of the Insubrian Gauls. The passage of Hannibal across the Alps has been a matter of much dispute, both as to method and locality.

Hannibal completed his march from New Carthage to Italy in five months, during which he lost a great number of men, especially in his passage over the Alps. His army was reduced to 12,000 Africans, 8000 Spaniards, and 6000 cavalry when he arrived in the territories of the Insubrian Gauls. His first battle was with P. Cornelius Scipio on the right bank of the river Ticinus (Ticino). The Romans were defeated, and Scipio, retreating along the left bank of the Po, crossed the river and encamped near Placentia. He afterwards intrenched himself strongly on the right bank of the Trebia, where he waited for the arrival of the army under the Consul T. Sempronius, who had been recalled from Africa. After the union of the two armies Sempronius determined, against the advice of Scipio, to risk another battle. The Romans were again defeated, and the troops which survived took refuge in the fortified cities. In consequence of these victories the whole of Cisalpine Gaul (the northern part of Italy) fell into the hands of Hannibal; and the Gauls of North Italy now eagerly assisted him with men and supplies.

In the following year (217) the Romans raised two new armies; one was posted at Arretium, under the Consul Flaminius, and the other at Ariminum, under the Consul Servilius. In Hannibal's progress through the swamps of the basin of the Arno his army suffered much, and he himself lost the sight of one eye. He marched past Arretium, ravaging the country as he went, with the view of drawing out Flaminius to a battle. Flaminius hastily followed Hannibal, and being attacked in the basin of the Lake Thrasymene, was completely defeated by the Carthaginians, who were posted on the mountains which encircled the valley. To conciliate the Italians Hannibal dismissed without ransom all the prisoners whom he took in the battle; and to give them an opportunity of joining his army he marched slowly along the eastern side of the peninsula, through Umbria and Picenum, into Apulia, but he did not meet with that co-operation which he appears to have expected.

After the defeat of Flaminius, Q. Fabius Maximus was appointed dictator, and a defensive system of warfare was adopted by the Romans till the end of the year. In the following year, 216, the Romans raised an army of 80,000 foot and 6000 horse, which was commanded by the Consuls L. Æmilius Paulus and C. Terentius Varro. The Carthaginian army now amounted to 40,000 foot and 10,000 horse. The armies were encamped in the neighbourhood of Cannæ in Apulia. In the battle which was fought near this place the Romans were defeated with dreadful carnage, and with a loss which, as stated by Polybius, is quite incredible. The Consul L. Æmilius, and the two consuls of the former year, Servilius and Attilius, were also among the slain. Hannibal lost only 4000 Gauls, 1500 Africans and Spaniards, and 200 horse.

This victory placed the whole of Lower Italy in the power of Hannibal. Capua and most of the cities of the Campania espoused his cause, but the majority of the Italians continued firm to Rome. The defensive system was now strictly adopted by the Romans, and Hannibal was unable to make any active exertions for the further conquest of Italy till he received a reinforcement of troops, though he marched up to the very gates of Rome, and performed other brilliant feats of strategy. Capua was retaken by the Romans, 211. Hannibal was therefore obliged to depend upon the Carthaginians for help, and Hasdrubal was ordered to march from Spain to his assistance.

The Roman army in Spain had been entirely defeated by Hasdrubal, 212. Both the Scipios fell in the battle. Hasdrubal was preparing to join his brother, but was prevented by the arrival of young P. Cornelius Scipio in Spain, 210, who quickly recovered what the Romans had lost. It was not till 207, when the Carthaginians had lost almost all their dominions in Spain, that Hasdrubal set out to join his brother in Italy. He crossed the Alps and arrived at Placentia before the Romans knew that he had entered Italy. But before he could effect a junction with Hannibal he was attacked by the Consuls C. Claudius Nero and M. Livius, on the banks of the Metaurus, in Umbria, his army was cut to pieces, and he himself fell in the battle. Hannibal's first notification of his brother's arrival was his brother's bleeding head flung brutally into his camp without a word. This misfortune obliged Hannibal to act on the defensive, and from this time till his departure from Italy, 203, he was confined to Bruttium, but by his superior military skill he maintained his army without any assistance from home.

After effecting the conquest of Spain, Scipio passed over into Africa (204). With the assistance of Massinissa, a Numidian prince, he gained two victories over the Carthaginians, who then hurriedly recalled their great commander from Italy to defend his native state. Hannibal landed at Leptis, and advanced near Zama, five days' journey from Carthage towards the west. Here he was entirely defeated by Scipio, B.C. 202; 20,000 Carthaginians fell in the battle, and as many more were taken prisoners. The Carthaginians sued for peace, and thus ended the second Punic War, B.C. 201.

After the conclusion of the war Hannibal vigorously applied himself to correct the abuses which existed in the Carthaginian government; but he thus incurred the enmity of many powerful men, who represented to the Romans that he was endeavouring to persuade his countrymen to join Antiochus, king of Syria, in a war against them. A Roman embassy was sent to Carthage to demand the punishment of Hannibal, but he escaped and sailed to Tyre. From Tyre he went to Ephesus to join Antiochus, 196, and contributed to fix him in his determination to make war against the Romans. But the king only employed him in subordinate commands, and he had no opportunity for the exertion of his great military talents. At the conclusion of this war Hannibal went to Prusias, king of Bithynia; and when a Roman embassy was sent to demand him of Prusias, Hannibal poisoned himself at Nicomedia, in Bithynia, 183, in the sixty-fifth year of his age.

The personal character of Hannibal is only known to us from the events of his public life, and even these have not been commemorated by any historian of his own country; but we cannot read the history of his campaigns, of which we have here presented a mere outline, even in the narrative of his enemies, without admiring his great genius, courage, and magnanimity. The extraordinary way in which, held at bay in a corner of an enemy's country, with his army a mere heterogeneous mass of men of all nations, he yet preserved the devoted allegiance of his followers undisturbed by a single mutiny, is certainly the most remarkable thing of its kind in history. Had the rest of the men of Carthage been as heroic as the general they so basely abandoned where had been the supremacy of Rome?

The meaning of the name Hannibal is *Grace of Baal*, Baal being the chief god of the Tyrians.

HAN'NO was a common name among the Carthaginians. It meant *grace* or *favour*. We distinguish among the most celebrated, Hanno the constant opponent of Hannibal and his father before him; leader of the aristocratic party, as they were of the popular party at Carthage. One of Hannibals best officers, who led the right wing at Cannæ, bore this name also. Two Hannos were crucified for defeats, a not uncommon manner of encouraging energetic generals in

Carthage. There were also Hanno who surrendered Messana to the Romans in 264, and Hanno whom Catulus defeated at sea in 241. The Hanno and Hannibal engaged together before Agrigentum in 262 have of course nothing to do with the great Hannibal or his favourite officer.

HANNO'S PERIPLUS is a small Greek treatise, entitled "The Periplus (*i.e.* voyage) of Hanno, king (*i.e. suffete* or commander) of the Carthaginians, round the parts of Libya beyond the Pillars of Herakles, which he posted up in the temple of Kronos." The treatise which we possess appears to be a translation of the Carthaginian document preserved in the temple of Kronos. The time at which this voyage was performed is uncertain; Pliny ("Nat. Hist." ii. 67) places it in the flourishing period of Carthaginian history.

The object of the expedition is stated at the commencement of the Periplus: "It was decreed by the Carthaginians that Hanno should sail beyond the Pillars of Herakles, and found Libyo-Phœnician cities. He sailed accordingly with sixty ships of fifty oars each, and a body of men and women to the number of 30,000, and provisions and other necessaries." The first city to be founded was Thumiaterion, near the Pillars of Herakles, probably in the neighbourhood of Marmara. The most southern was Kerne. From Kerne the voyage was one of discovery; and after advancing as far south as Sierra Leone or Sherbro, according to Rennell, he was obliged to return through want of provisions. The best edition is in the "Geographi Græci Minores" of Gail (Paris, 1831), with a Latin translation and notes variorum.

HAN'OVER, formerly an independent kingdom in Germany, but annexed as a province of Prussia in 1866, is bounded on the N.W. by the German Ocean, N. by the Elbe, E. and S.E. by Brunswick, S.W. by Hessen-Cassel and Lippe, and W. by Holland. The area is 14,845 square miles, and the population in 1881 was 2,120,168. The Germans write and pronounce the name *Hanno'ver.*

The southern parts are mountainous, but from the cities of Hildesheim, Hanover, and Osnabrück to the sea-coast the whole country is a vast plain, with occasional small elevations. The mountains abound in mineral wealth, and are covered with forests of red pine and fir, with some oaks and other timber. A broad sandy tract crosses the country from east to west between the mountains and the sea. The coasts are under the level of the sea, from the encroachments of which they are protected by dykes. The principal rivers are the Elbe, the Weser, and the Ems, which receive in their course numerous secondary streams, as the Aller, Leine, Ilmenau, and Lühe, and empty themselves into the German Ocean. There are only two large lakes: the Steinhudermeer and the Dümersee. The rivers and lakes abound in fish. In East Friesland is the subterraneous Lake Jordan, the surface of which is so thickly overgrown with vegetation that waggons can pass over it.

The climate is damp and unwholesome in the low country about the coast; but the winters are not so severe as in the interior, where, especially near the Harz, they begin in September and terminate in May. The spring is the most gloomy and disagreeable part of the year, owing to the long prevalence of the north-east and east winds. South-west winds prevail in the summer months. The fall of rain during the year averages 23·5 inches, but it is very unequal in different parts of the kingdom. Fogs prevail in the dyke-lands; and in the winter violent storms frequently occur, causing great damage to the embankments and drainage.

Agriculture, the chief source of subsistence of the inhabitants, is much favoured by the facilities for exportation, as well as by the transit trade and the consumption of the neighbouring maritime towns. In the marsh land the breeding of cattle is more followed than agriculture. The horses of East Friesland, which are celebrated, are bred for exportation. The rearing of cattle and sheep, though not of the same importance as horse-breeding, is attended to extensively. Bees are a favourite addition to a farm throughout the country, and thrive well, on account of the quantity of flowering heath and buckwheat in the sandy district. The annual produce of honey is valued at £50,000. Large flocks of geese are kept in moist situations: their flesh is salted for domestic use, and the feathers are preserved. Leeches, which formerly abounded in the marsh lands, have become nearly extinct, from being too eagerly fished.

Three-fifths of the whole land in the country is in the hands of owners whose average property is only 12 acres in extent. These small landowners, called *Bauern*, are a race of hard-working men, and on the whole very happy and comfortable, poverty being almost unknown among them. The best cultivated lands, however, belong to the government and the nobility, and on these estates much attention is given to improved systems of tillage.

Potatoes are universally planted, and constitute the chief food of the poor. Rye is generally grown for bread, the raising of wheat being confined to the rich weald soils, but the quantity is insufficient for the demand. Barley and oats are largely cultivated, and, when in demand, exported in considerable quantities. Clover and lucerne are much grown on good farms, and even by the peasants on dry soils. Turnips are a favourite article of production. Flax, hemp, tobacco, and hops abound in different parts. The cranberries, which are plentiful on the heath lands, are gathered for exportation. Timber and wood of various descriptions form an important item of foreign commerce. The forests are under special control, and even when forming part of private property, are confided to foresters scientifically educated and licensed specially for the purpose.

Mining is the most important branch of industry. The mineral wealth of the country, which is considerable, lies, with the exception of coal, for the most part in the mountainous districts, thickly clothed with forests, which constitute the Hanoverian portion of the Harz, and in that district called the Lower Harz. The chief products of the mines and quarries include iron, copper, lead, litharge, salt, turf, coal, alum, marble, and granite. The principal manufactures are linen, hemp, woollen and cotton fabrics, paper, soap, leather, and hats. Brewing and the manufacture of metal are important branches of industry. The country is traversed by excellent roads, and has good railway accommodation. There are also several excellent canals. The commerce of Hanover is not extensive, and it is conducted mostly by the towns of Bremen and Hamburg. The principal exports are linens, yarns, and agricultural and mineral produce. The imports comprise manufactured goods, colonial produce, wine, and spirits.

The great majority of the inhabitants of Hanover are members of the Lutheran Church. Like other parts of Germany, Hanover is well provided with educational institutions. The most celebrated is the university at Göttingen.

History.—In the remotest times of which we have any record, the countries between the Elbe and the Weser were inhabited by small independent tribes of hunters and herdsmen. When Charlemagne first introduced the Christian religion, the country was in the power of the Saxons. Otho the Great gave in 970 the investiture of the duchy of Saxony to Hermann Billing, a wealthy lord in Lüneburg; and his descendants, by acquiring also the principalities of Brunswick and Göttingen, laid a foundation for the larger electorate. But numerous petty broils occurred, and many little republics rose, several of which became considerable cities. The Hanseatic League found great favour here, and of the eighty-five towns composing that celebrated confederation thirteen were in the late kingdom of Hanover. The subsequent history of Hanover presents very little of interest, until, by the death of Queen

Anne, the elector succeeded to the British throne. In consequence of this event, the electors of Hanover continued to be kings of Great Britain, till, on the death of William IV., the crown of Great Britain devolved on Queen Victoria, and the succession to the throne of Hanover being limited to the male line, the two countries were separated. The Duke of Cumberland, eldest surviving brother of King William, ascended the throne of Hanover by the name of Ernest Augustus. Hanover was for the most part prosperous during the eighteenth century; but it suffered many diversities of fortune during the wars consequent on the French Revolution, and was frequently in the hands of the French. After the battle of Leipzig in 1813 the whole electorate was restored to the lawful king, who assumed in 1815 the title of King of Hanover, that of elector having in fact ceased by the dissolution of the German Empire. In 1816 the Duke of Cambridge was appointed governor-general of Hanover, and in 1819 a new constitution was granted, and two representative chambers associated with the provincial states. In 1833 another constitution was drawn up and signed by William IV., but at his death the Duke of Cumberland (the new king) abrogated it, and restored that of 1819. He was, however, obliged to sanction numerous liberal measures and reforms in 1848. He died in 1851, and was succeeded by his son, the last king of Hanover, who died in 1878, and was buried at Windsor.

At the commencement of the war between Prussia and Austria in 1866, Hanover was called upon by the former to put its army on a peace footing, and to accept its plan of the new German confederation, under the penalty of being treated as an enemy of war. Having declined to accede to these demands, the country was invaded and speedily subdued; and at the conclusion of the war it was constituted an integral portion of the Prussian kingdom, and its soldiers fought valiantly against the French in the war of 1870. The deposed king had retired to England and resumed his rank as Duke of Cumberland, though he always refused to acknowledge the cessation of his royal dignity.

HANOVER, the capital of the above province, is situated in an agreeable and well-cultivated plain on the river Leine, which is navigable from the city to its junction with the Weser. It consists of three parts—the Old Town, the Ægidian New Town, and the New Town on the left bank of the river. In the first the streets are for the most part crooked and narrow, and the houses old-fashioned and irregular; but the two other parts are handsomely and regularly built, and the town is one of the brightest and most pleasing in Germany. In consequence of its advantageous situation, at the junction of several important railways, Hanover has risen considerably in importance, and is now a thriving manufacturing town. The most interesting public buildings are the theatre, one of the finest in Germany, the museum of art and science, picture gallery, palace, and town-hall. Among the charitable institutions are the orphan asylum, infirmaries, hospitals, and poor-houses. For the purposes of education there is a collegiate school for the sons of noblemen, called the Georgianum, a lyceum, a female school of industry, many elementary schools, and a seminary for schoolmasters. About a mile and a half from the city is the palace of Herrenhausen, which was the favourite residence of George I., George II., and George V., the last king of Hanover, who died 1878. Hanover was founded in the eleventh century. Its walls, with five gates and broad ditches, were in 1780 partly levelled and laid out in streets, and the remainder converted into a handsome esplanade. The population of Hanover in 1881 was 122,860, or including the suburb of Linden 145,000. In 1887 the population was only 27,500.

HAN'SARD'S DEBATES, or reports of the parliamentary sessions, are the recognized authority for reference to anything that has been said or done in the English Parliament. They comprise a record of all the speeches made in both houses, collected chiefly from the London daily papers, and generally revised and corrected by the speakers themselves. The printing and publishing of these debates is purely a private speculation carried on by the Messrs. Hansard. The work is issued at a fixed price—generally five guineas—computed and guaranteed at the commencement of each session. More than once, of late years, the publishers have been left without any remuneration for their pains, and at one time there seemed a prospect of the publication being abandoned. Such a contingency was regarded with great apprehension by many members of Parliament, more especially as very few even of the great newspapers furnished ample records of debates. In 1880 the government met the difficulty by granting a small subsidy to Messrs. Hansard on condition of their continuing the publication of full reports.

HANSEAT'IC LEAGUE or **HANSA** (Ger. *hanse*, Goth. *hansa*, a league), a celebrated commercial confederacy which was established in the thirteenth century by certain of the cities of Northern Germany for mutual support and the furtherance of their trade. For more than a century previous the cities of Hamburg, Lübeck, and Bremen had been growing in size and importance, and gradually becoming the depositories of the manufactures of Italy and Germany, with which they supplied the northern countries of Europe in exchange for their raw produce. They had formed important mercantile settlements in several of the great northern towns, but their increasing wealth exposed their merchants to many dangers. On land the rapacity of the princes and nobles led to the imposition of new and the augmentation of old tolls and imposts, which were great impediments to trade, and at sea they were exposed to the attacks of rovers and pirates, by which the coasts were infested. Hence arose the practice of a number of the merchants combining together for mutual support, and for all the merchants of one city to unite in the defence of their trade. [See GUILD.] A still greater advance was made in 1219, when the cities of Hamburg, Ditmarsh, and Hadeln entered into a compact to unite their forces for the protection of the course of the river and the adjacent coasts. In 1241 Hamburg and Lübeck concluded an alliance by which they engaged to maintain a naval and military force for the protection of their commerce, and the city of Brunswick joined the league in 1247. The advantages of this union soon became manifest, and other towns on the Baltic and in neighbouring states entered into the alliance, and by the time the first diet of the league met at Lübeck in 1260 a complete system of administration had been drawn up and got into working order. In course of time most of the trading towns of Europe joined this association, which included, in addition to those mentioned, Rouen, Bordeaux, St. Malo, Bayonne, Marseilles, Barcelona, Seville, Cadiz, Lisbon, Antwerp, Dantzic, Dort, Amsterdam, Rotterdam, Ostend, Dunkirk, all the towns in the Baltic, the Elbe, and the Weser, with others, to the total number of eighty-five. Their principal factories in foreign countries were Bruges, London, Novgorod, and Bergen.

The cities composing the league sent their representatives to the diet, which met every three years, generally at Lübeck, for the settlement of the regular business, and to a special meeting, which was held every ten years to renew the various unions which constituted the league. The union was divided into four circles:—(1) The Wendian, which included the cities of the Baltic, and was presided over by Lübeck; (2) the Western, including the towns of the Netherlands, the Rhineland, and Westphalia, presided over by Cologne; (3) the Saxon, for the towns of Saxony and Brandenburg, with Brunswick at their head; and (4) the Eastern, of the towns of Prussia and Livonia, under the presidency of Dantzic.

The objects of the league being the protection of its members on land and by sea, and the defence of their privileges against the interference of princes and rulers, a considerable military and naval force became a necessity, and the league assumed a political as well as a commercial character. In its wars it was often very successful, its most important victories being over the Kings Eric and Hakon of Norway, Waldemar III. of Denmark, and Magnus of Sweden, whom it deposed. In 1428 the combined towns sent a fleet of 248 ships, carrying 12,000 soldiers, against Eric, king of Denmark. It was during the fifteenth century that the league reached the highest point of its power and influence, but it began to decline during the first half of the sixteenth, and never again recovered its former strength. The members of the league, pursuing a proud and exclusive policy, raised a spirit of hostility in the countries where they traded, which after a time made itself manifest in active opposition. The herring fishery, which had formed one of the chief sources of the wealth of the Hanse merchants, was lost through the migration of the shoals to the coasts of Holland. The discovery of America and the finding of the way to India round the Cape of Good Hope turned trade into other channels, and opened up new commercial routes, in which the old ports were placed at a disadvantage; and as their power declined that of the princes of Germany was being greatly increased. In the fifteenth century the Hanse merchants of London had been deprived of their privileges, fined, and threatened with expulsion; but the league then possessed such influence that it prevailed upon Edward IV. to restore nearly all its former prerogatives and confirm them by treaty. When, however, at the close of the sixteenth century, they were obstinate in the maintenance of their privileges, Elizabeth sent a fleet, under Drake and Norris, against them, captured sixty-one of their ships, and banished their merchants from London.

Religious disturbances and the consequences of the Thirty Years' War hastened the decline of the league, and at the diet of Lübeck held in 1630 the deputies of the majority of the cities appeared merely to declare their secession from it. In 1669 the last general assembly was held, but the name of Hanse towns was maintained by Hamburg, Lübeck, and Bremen, which remained free republics until 1810, when they were incorporated by Napoleon in the French Empire. In 1813 they were again separated from France, and with Frankfurt-on-the-Main were designated the Free Hanseatic Cities of the Germanic Confederation. In 1866 Frankfurt was annexed by Prussia, but in 1870 the powers and privileges of the other three cities were confirmed by a convention.

Among the latest works on the history of the Hanseatic League are Barthold's "Geschichte der Deutschen" (Hamb. 1830); Wehrmann, "Die Lübeckischen Zunftrollen" (Lübeck, 1872); Schäfer, "Die Hansestädte und König Waldemar von Danemark" (1878).

HAN'WAY, JONAS, was born at Portsmouth in 1712, and died in 1786. He was a Russian merchant connected with the trade into Persia. Business having led him into Persia, he published in 1753 his "Historical Account of the British Trade over the Caspian Sea, with a Journal of Travels from London through Russia into Persia," &c., four volumes 4to, now very valuable through the lapse of time. His accounts of Frederick the Great, whom he visited in his travels, are now very interesting. He was made a commissioner of the navy. The Marine Society and the Magdalen Charity owe their establishment mainly to him; he was also one of the great promoters of Sunday-schools.

HAPPINESS. Until the present age, when happiness has been taken as the end and aim of life, and an action is to be tested as to its moral standing by its effect upon happiness, by the great and rapidly growing school of moralists professing UTILITARIANISM it has often seemed to be considered that one person could not be happy except at the expense of others, as if there were a common stock of happiness from which the quantity drawn by one individual was so much lessening what was left for the rest. So much is this still the case that utilitarians, who alone among moralists profess universal benevolence, are stigmatized as holding the "Selfish Theory." Thomas Carlyle denounces in his atrabiliar fashion this "Pig-philosophy" as he calls it ("Past and Present"). "Moral evil," sneers he at the hungerers after happiness, "is unattainability of pigswash; moral good, attainability of ditto. It is the duty of all pigs at all times to diminish the quantity of unattainable and increase that of attainable;" with much more of the like or of bitterer sarcasm. But is it the case? Does not the innocent happiness of children at play, or even of young animals, as kittens, puppies, &c., smooth the brow of care and bring a moment of happiness to the most troubled breast by sheer sympathy? The sight of happiness breeds happiness, and so far from happy men being selfish and exhausting the world's store of happiness they increase it by the very fact of their existence, while the sighers and groaners murder happiness by their contagious melancholy.

It is alleged, however, that even if not obtained at the cost of others, self-regarding happiness is a poor possession. True happiness, say the loftier spirits, is to forget one's self and live wholly for others; and indeed at the first blush this seems the generous and noble theory to hold. But a moment's consideration shows that it requires qualification. For, first, if everyone were to neglect his own concerns and look after those of others, the whole community would certainly be wretched; whereas if it were felt to be a duty to make the best of life not only for one's own sake, but as a contribution to the general welfare, the whole community would certainly gain immeasurably in happiness. And, secondly, it is not meant that an endeavour after personal happiness is to cover such paltry victories as are won by the usurer who wrings from starving debtors enough to buy his fine carriage and his sumptuous dinner; for to fine minds not only is unlimited indulgence anything but synonymous with happiness, but also no pleasure can exist which is consciously purchased by another's pain. It is only a case of more or less time before such pleasure is found to result in pain.

Further, it is certainly necessary to happiness, in any well-constituted mind, that not only shall others not be damaged by our existence, but that through sympathy, through charity, through united action for a good end, they shall on the contrary be benefited. This, then, the searcher for happiness adds to his care of himself. Care for one's self, care for one's self as one of others, care for others as part of care for one's self, these are the three steps in the theory here advocated. Happiness is to be an end in itself, according to this rejuvenescence of the ancient theories of Epicurus. The whole world may be happy, not by each one forgetting himself, but by each one carefully studying himself (his highest and best self being understood). We have stated this delightful happiness-theory of morals, and it may be added in the words of our greatest Englishman—

"Tis a consummation devoutly to be wished."

Passing from happiness as an ethical end, as a duty, we have now to consider what happiness is, wherein it consists, whether it can be increased, &c.; in short, we have to endeavour to find out the nature of happiness.

By happiness much more than mere pleasure is meant. Some permanent and lasting satisfaction to the fundamental needs of one's nature is implied by the term. Happiness, indeed, is the perennial source of pleasures, not the single pleasures themselves. A great aim attained, nobly and without exhaustion, brings happiness, at all

events for a time—a loving wife won, a competent fortune, a wide knowledge, or a respected position attained; for these are not mere isolated fleeting pleasures, they are the fruitful origins of many pleasures. Consequently aims like these are chosen by the seeker after happiness; but so absorbing are they that they always tend, unless watched, to become "ends in themselves." How many men forget the aims with which they started in the race for wealth, and abandoning the realization of happiness by means of the wealth, come to love the miserable dead coin for its own sake, and so spoil their whole life! But to those who are wiser than to be so deceived, the earnest pursuit of a noble end, in addition to promising a future happiness, satisfies that craving inherent in mankind for something whereupon to expend the force of life, some theatre of activity, the want of which causes the terrible disease of *ennui;* and thus it provides a present and very great fund of happiness. And especially is this the case if the effort is in the main successful; for, added to the charm of "plot-interest" felt by us all in any train of progressing events, there will supervene a great satisfaction at the successive achievements themselves. Further, if the pursuit be one which involves mental or moral victories, the feeling of self-gratulation at having risen by these small victories just so many stages higher in the intellectual or moral scale is among the greatest forms of happiness we possess. Not only do men

"Rise on stepping-stones
Of their dead selves to higher things,"

but in the rising they have acquired enlarged resources for still further flights, as well as a present heightened worth and dignity.

The wise man has also to balance the great permanent ends of life with one another. If his chosen pursuit be wealth, for example, he must attend to the claims of the intellectual and artistic sides of his nature; he must not overstrain his health nor neglect his family and political duties, though he may hold all these subordinate to his principal end.

We have now to consider another very important factor in happiness—the twofold action of the will. By the control of the attention the will of man can either turn the mind towards or away from the contemplation of things. It may be exerted to retain or to restore pleasurable states of mind, or to drive away painful thoughts. Those who are well acquainted with the life of Dr. Johnson will see by his shining example what immense results can thus be attained. A man weakly in body and in mind, as gloomy as Thomas Carlyle by nature, he succeeded by sheer force of will, exerted continually to put away morose and painful views, in achieving happiness beyond the common lot. Somewhat the same might be said of Harriet Martineau. We have, if we care to exercise it, a very large selective power over our circumstances, and it behoves us to dwell by preference upon the sunny sides of our fortune. Besides, we thus gain the more strength to meet storms when they come. We cannot, it is true, think away a pain, but we can think of something else to the exclusion of our attention from that pain; and this comes much to the same end. Does the ardent lover feel the rain which beats upon him as he hastens to the object of his devotion, or will the pangs of hunger draw the mathematician away from the conclusion of a long-sought problem?

It is necessary also, not only to watch lest our chief aim in life tend to interfere with other aims, and to become narrowed to an end in itself instead of being pursued as a means of happiness, but to keep the mind free in our advancing growth for the perception of the new pleasures which continually open out before us, or of higher aims, or of nobler conceptions of the aims we already have. In this way our mental horizon continually enlarges, and even what we may have failed to accomplish may be regarded not as a source of pain so much as a pleasure yet remaining to be won in the future. It is a certain death to happiness when every aim is reached, every ideal attained; when nothing remains but to become a *laudator temporis acti*, a moralizer on the "good old times," and to decay and die. On the other hand, the truly happy man is he whose aims are not limited to himself alone, but embrace the progress and welfare of the race; for as his own vigour fails he can yet see other men with pleasure pressing onward to a further goal, aided and cheered by his own past efforts. Life is sweet and full of interest to the very end, and he is able to look forward with pleasure to things which lie even beyond his own death.

Of the great happiness to be derived from the sense of a religious peace, this is not the place to treat. It needs only to be referred to here as at once the noblest and the deepest joy we are privileged to experience.

The question remains, to be briefly discussed, of the relative value of various pleasures as contributors towards happiness. Here we can with confidence pronounce upon the existence of higher and lower levels. The low-pitched pleasures of the table cannot give happiness; they are short, evanescent, very limited, and carry with them swift and severe punishment, even to their own utter exhaustion, if they are more than very moderately indulged in. So with every sensual indulgence. The seeker after happiness must rise above these temporary gratifications. The pursuit of refined intellectual and moral joys gives not only more enduring pleasures at the time, ending in a permanent factor for happiness, but these pleasures are far more readily recoverable in idea. A cultured musician can enjoy the highest possible delight for several hours at a stretch, and can then after an interval recall in thought the same gratification with almost equal intensity. The gourmand's pleasure, on the other hand, is exhausted after but a brief enjoyment, and his palate refuses to work in idea except very faintly; the image and the morsel itself are not even remotely comparable in intensity. Further, the higher pleasures are to be shared in by large numbers. Hundreds can enjoy a picture or a concert together, while the winebibber enjoys his glass to himself alone. Beyond this, too, the lower or animal pleasures bring with them intense desires or actual cravings, and unsatisfied desire is the keenest form of pain, whereas the higher pleasures are realizable in idea at any time. Lastly, the power for all sensual enjoyments leaves us as we advance in life, but the perennial delights of the mind and the heart remain to cheer their fortunate possessors even when they are

"Sans teeth, sans eyes, sans taste, sans everything."

It is clear, therefore, that these pleasures, nobler in the eyes of others, widespread in their action, enduring in their nature, and incapable of satiety, are to be selected as the materials of happiness, to the comparative neglect of selfish, limited, sensual, and animal gratifications.

Is, then, "life worth living?" Is this happiness, spoken of as attainable, attainable in sufficient quantity to outweigh the many ills that flesh is heir to? Is optimism (the belief in the possibility of progress towards a general well-being) or is pessimism (the belief that there is no such possibility) the true creed? We pronounce for optimism, but with an important proviso. We say, "Life is good, *provided we make the best of it,*" a view called by one of our greatest novelists (George Eliot) *meliorism.* But there is much to be said for the unhappy creed of PESSIMISM, necessarily relegated to the article under that heading. With our increased capacity for pleasure comes an increased capacity for pain, it is true; and who has not pessimistic moments, when the world is black and dreary—produced, it may be, by the liver requiring medical attention? For, humiliating as it may seem, it is nevertheless the fact that a happy disposition is dependent to an incredible extent upon

the comfortable state of the animal organs. "The devil," says Luther, "hates a hearty laugh." A full and vigorous activity and a healthy stomach are the very death of pessimism. When Schopenhauer, the prophet of this gloomy creed, proclaims that "the world is the worst possible compatible with its existence" (for some quantum of pleasure is necessary to keep us all from suicide), we are inclined to ponder on the idiocy of his grandmother and his uncle, the gloomy passion and probable suicide of his father, and the contemptuous misanthropic solitude in which the man himself devoured his own heart amid unsatisfied ambition till just upon the close of life, and in these to find the reason why to him this world was for ever bare of happiness.

HAPS'BURG or **HABS'BURG, HOUSE OF,** an old German family which derives its name from the castle of Habsburg, or Habichtsburg (Hawk's Castle), upon the river Aar, in the canton of Bern. The earliest mention of the countship that can be found dates from 1099, but the castle was built about the year 1020, and the founder of the family is said to be Radbotar, grandson of Gontram the Red, count of Brisgau. Rudolf, the founder of the Austrian dynasty, was born in 1218, and was the son of Albert, count of Habsburg in Aargau, and of Hedwige of Kyburg, who was descended through her mother from the once powerful house of Zäringen, and whose possessions he afterwards inherited. Having distinguished himself in the management of his own dominions, he was elected Emperor of Germany in 1273, and in 1278 he annexed to his possessions Austria, Styria, Carinthia, and Carniola. The dignity was continued to his successor, but was lost to the family at the end of the third life, to be restored again to Albert II. in 1438. From this time the office of Holy Roman Emperor remained in the family until the male line became extinct with the death of the Emperor Charles VI. in 1740. His daughter, Maria Theresa, having married Francis of Lorraine, grand-duke of Tuscany, an attempt was made to dispossess her of the imperial crown, but it failed, and the succession was transmitted in the line of Habsburg-Lorraine, from which the present imperial dynasty of Austria is descended. When the male line became extinct in 1740 the family had already given twenty-two sovereigns to Austria, sixteen emperors to Germany, eleven kings to Hungary and Bohemia, and six to Spain. The aggrandizement of the family was mainly brought about by a series of fortunate marriages, and from one of these between Ernest the Iron and a niece of Iagellan, king of Poland, the thick-hanging under lip which characterizes its members is said to have been derived.

The Castle of Habsburg, with the territories of Aargau, passed away from the family in 1474. Two square towers of the castle still remain standing on a steep hill on the right bank of the Aar, not far from Brugg, and opposite the baths of Schinznach. The sepulchres of the family, which were at Königsfelden, in the neighbourhood, have been removed to St. Stephen's Cathedral at Vienna.

HARBOUR, a port or haven for shipping, so protected from the winds and waves as to secure a safe shelter for ships. In many places a shelter of this kind is afforded by the conformation of the land, and the protected spot is termed a natural harbour; in others the result has to be obtained by artificial means. Harbours of refuge are deep roadsteads where ships may enter at all times during storms, and are generally protected by BREAKWATERS. Sometimes a harbour of refuge is made to contain an inner harbour for commercial purposes, as at Plymouth. Ordinary harbours are formed in the mouths of rivers or other inlets of the sea, and are mostly tidal. Where there is much commerce a tidal harbour is usually provided with an inclosed dock, into which ships are admitted during high water, and where they can be loaded or unloaded without the inconvenience caused by the rising and falling of the tide. See DOCK.

In the earliest infancy of commerce the Phœnicians seem to have felt the necessity for artificial harbours, and such were constructed both at Tyre and Sidon. The sea walls of these appear to have been made of large blocks of stone built upon a rubble foundation, very much after the fashion in which many modern structures are erected, but the dimensions of the harbours thus made seem to have been exaggerated by the ancient historians. The Greeks, who built immense fleets both for warlike and commercial purposes, possessed so many natural harbours and roadsteads as to render the construction of artificial harbours almost unnecessary. They seem, however, to have improved their natural advantages in many places by the erection of breakwaters, moles, and piers, chiefly in behalf of their ships of war. Ancient Carthage possessed a magnificent harbour, and several very solid artificial harbours were constructed by the Romans. In the mediæval period the revival of commerce by the Italians resulted in the construction of suitable ports at Genoa and Venice, and similar works were soon afterwards carried out in France. Great progress in marine engineering was subsequently made upon the Continent, in which all the maritime nations participated, but England remained practically without any efficient artificial harbour till about the latter half of the eighteenth century. Since that time, however, the progress has been rapid, and breakwaters and protecting piers have been erected at most of the numerous ports encircling our island. The essential qualities of a good harbour are that it shall be easy to enter or to leave, that it shall afford adequate protection against wind and wave, possess a good depth of water, and give proper facilities for lading, repairing, &c. In the construction of a harbour very many points have to be taken into consideration, such as the geological and physical peculiarities of the coast, the force of the waves, the strength and direction of the tides, the depth of water, the line of greatest reach of open sea in front, and the angle at which the waves strike with their greatest force. Careful observations as to the height and force of waves have been made by civil engineers, and some very striking instances concerning both points have been recorded. Dr. Scoresby, who carried out a series of careful measurements in the Atlantic, found that some of the waves attained the height of 43 feet, and at Wick, in Caithness-shire, waves 40 feet high have been observed to strike the breakwater during storms. The latter place is also remarkable for the greatest recorded instance of the force exerted by the waves, which happened in 1873, when a mass of concrete containing 1500 cubic yards of cement rubble, and weighing about 2600 tons, was moved out of its position and carried to the leeward of the breakwater, then in course of erection.

There has been much discussion as to which form of wall is best adapted to resist the force of the waves, the chief points in dispute being the rival advantages of perpendicular or sloping constructions. It is, however, universally agreed that the arms of a harbour should be constructed so as to afford the waves as little direct resistance as possible, even a slight outward curve or cant has been found to afford great relief by diverting the force of the water.

The materials chiefly used for constructing the walls of harbours are wood, stone, and iron, either separate or in combination. Timber frames or boxes filled with stones have been used in the making of harbour walls from a very early period, and there are many places where such erections can still be made very useful. It has been found that where the soil is soft, and there is a good admixture of fresh water, that beams of pine are suitable for the work, but where there is much exposure or where they are immersed in sea water alone they are rapidly destroyed by the abrasion of the waves and the ravages of marine worms. Experiments have been made in order to ascertain the kinds of timber best adapted for marine work, and it has been discovered that green-heart offers the greatest resistance, though even this is by no means impenetrable,

and in some places is readily attacked. African oak, bullet tree, and teak are also very useful. Even some kinds of stone are perforated by marine worms, but the harder varieties are generally proof against such attacks. Granite seems to offer the strongest resistance to the abrading action of water, and it is largely used for facing exposed surfaces. The material most relied on at the present day is concrete, made up of Portland cement and rubble or gravel. It can be made into blocks of any size, sets readily in still water, and when set is nearly as durable as stone. Iron, when used for piers, &c., oxidizes freely, and galvanizing only affords protection for a few years. Wrought iron resists the chemical action of sea water much better than cast iron, the difference being stated as that of eight to one. According to some experiments carried out by Mr. Mallet, wrought iron will lose about six-tenths of an inch in a century when immersed in clean salt water, but of course the loss will be much greater when the metal is exposed to the action of the waves and the scouring of the sand, &c., held in suspension by the water. Some cast-iron bars at the Bell Rock which were immersed every tide were found to have lost half their strength in fifty years.

(See Sir J. Rennie, "Theory, Formation, and Construction of British and Foreign Harbours," London, 1854; T. Stevenson's "Design and Construction of Harbours," second edition, Edin., 1874; and the "Minutes of Proceedings of Institution of Civil Engineers.")

Laws of Harbours and Ports.—In Great Britain the right of appointing suitable places to be ports and havens is vested in the crown, except in such cases where the right has been held from time immemorial, or has been given by royal or parliamentary grant. In England any individual or corporation obtaining a grant of a harbour is bound to keep it in proper repair and to levy such dues and tolls as may be conformable to custom. In Scotland the obligation to keep the harbour in repair extends only to the amount of the dues received. A Consolidation Act for the regulation of the management and construction of harbours, and for defining the law as to the levying of dues and tolls, was passed in 1847 (Act 10 & 11 Vict. c. 27), which applies to the whole of the United Kingdom. It has been amended by the Acts 24 & 25 Vict. c. 45, 25 & 26 Vict. c. 69, and 28 & 29 Vict. c. 100. There are many harbours, however, which are regulated by the provisions of local Acts passed to meet the peculiar wants of the locality.

HARD LABOUR, an addition made to a sentence of imprisonment when the offence deserves such punishment and the condition of the prisoner will allow of it. Justices have the power of inflicting hard labour both for indictable offences and for those disposed of summarily, when the offence is of an aggravated character. It generally consists of working on the tread-mill, picking oakum, breaking stones, making mats, &c., and is limited to ten hours a day. As the diet is of a limited character a long term of hard labour forms a very severe punishment, and two years is the maximum period for this sentence.

HAR'DICANUTE. See HARTHACNUT.

HAR'DINGE, RIGHT HON. LORD HENRY, Governor-general of India, a field-marshal of England, and commander-in-chief of the British forces, was a younger son of the Rev. H. Hardinge, rector of Stanhope, county Durham, and born in 1785. Few men had more experience in the tented field. He entered the army as an ensign in his fifteenth year, served through the Peninsular and Waterloo campaigns with the most distinguished gallantry, and lost his left hand at the battle of Ligny. In 1823 he was appointed clerk of the ordnance, and entered Parliament in 1826. During the premiership of the Duke of Wellington he was made secretary of war, and in 1830 he was appointed secretary for Ireland. When Sir Robert Peel came into power he resumed his post of secretary of war, and efficiently discharged its duties till 1844, when he was appointed to the important position of governor-general of India. There are few epochs in the eventful history of our Indian Empire more momentous than the one for which the administration of Sir Henry Hardinge was distinguished. The war with the Sikhs, who at one time threatened the safety of our northern territories, will be ever memorable in history. The battles of Moodkee, Aliwal, and Sobraon, in which Sir Henry took a prominent part as second to Lord Gough, have immortalized the period. On the termination of this severe but important contest Sir Henry was created Viscount Hardinge of Lahore. Parliament granted him an annuity of £3000 for himself and his two next successors; and the East India Company gave him a pension, in addition, of £5000 a year. On the death of the Duke of Wellington in 1852 Lord Hardinge was appointed commander-in-chief, and during the same year was advanced to the rank of field-marshal, being the highest reward which can be conferred on military genius. He died 24th September, 1856.

HARDNESS OF MINERALS. It is highly desirable to get some scale of hardness by which definitely to be able to describe the variations of minerals in this particular. Starting from the diamond as the hardest of known substances, Mohr drew up the following list. He reasoned thus: hardness may be estimated by the power of one body to scratch another. Now, most sapphires may be scratched by a diamond (the hardest sapphire, however, will even resist the diamond), but by nothing else; topaz will resist everything else but sapphire and diamond; quartz will resist all but topaz, sapphire, and diamond, and so on. The scale he suggested, which is universally used, though it receives additions at the hand of each mineralogist for his own purposes, is this:—

1. Talc (the common laminated light-green variety).
2. Gypsum (the crystallized variety).
3. Calc spar (transparent).
4. Fluor spar (crystalline variety).
5. Apatite (transparent).
6. Felspar (white cleavable orthoclase).
7. Quartz (transparent).
8. Topaz.
9. Sapphire (cleavable).
10. Diamond.

If a mineral will scratch calc spar, but not fluor spar, it is said to be of the hardness 3·25 or 3·5, &c., as may be determined; at all events of between 3 and 4 degrees of hardness. As applied to geological investigation, hardness is found to have little to do with the permanency of minerals, for the extremely hard granite will weather into clay deep into its mass, while the comparatively soft limestone near by shows a smooth unweathered surface. This is because of the relative susceptibility to the chemical agency of the atmosphere.

Pure metals are always softer than alloys. For coinage and for manufacturing purposes gold, silver, and copper are better alloyed; in fact as regards the first two they would be otherwise unusable from their want of durability. Gold and silver are alloyed with copper, copper with zinc.

It may be asked, How is it possible to cut and polish the diamond since nothing can scratch it? This is quite true, and diamond dust is the only means of working diamonds. The power of cutting given by rapid motion is also brought into play, and it is found that a diamond can be ground down by friction on a rapidly rotating disc covered with diamond dust, with tolerable facility. The power of rapid motion in overcoming the resistance of hardness is often effectively shown in the lecture-room by the favourite experiment of shooting a tallow candle through an inch deal plank from a gun properly loaded. A stream of sand driven by a strong wind (sand-blast) can cut and polish

very hard substances with the greatest ease. This is shown also in nature by the scooping out of the dry *wadys* (rock valleys) of Palestine by the driving sand.

HARDWAR, an ancient historical town and place of pilgrimage in Saharanpur District, North-western Provinces of India, with a population of 5000. The Ganges here divides into many shallow channels, intercepted by islands. The town is of great antiquity, and has borne many names. *Hardwár*, or Hari-dwára, literally "Vishnu's Gate," seems to be of comparatively modern origin.

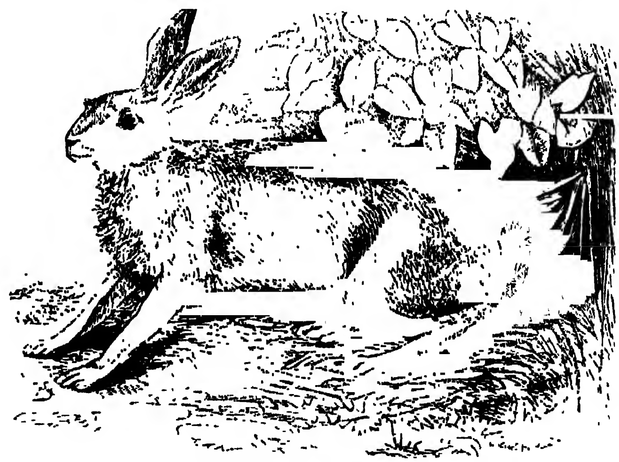
The great object of attraction at Hardwar is the Hari-ke-charan or bathing *ghát*, with the adjoining temple of Gangadwara. The *charan*, or foot-mark of Vishnu, is said to be imprinted on a stone let into the upper wall of the ghat, and forms an object of special reverence. Each pilgrim struggles to be the first to plunge into the pool after the propitious moment has arrived, and stringent police regulations are required to prevent the crowd trampling one another to death, and drowning each other under the sacred water. The great assemblage of pilgrims takes place on the first day of the month of Baisakh (part of March and April), the commencement of the Hindu solar year, and the anniversary of the day upon which the Ganges first appeared upon earth.

The ordinary number of pilgrims at the annual fair amounts to 100,000, and every twelfth year 300,000 The total was formerly given in much larger figures.

HARDWARE MANUFACTURES—the great seats of which are at Birmingham, Sheffield, Wolverhampton, Walsall, &c.—are among the chief sources of the wealth of England. The term includes the smaller articles made of any of the commoner metals, such as grates, tools, locks, keys, shovels, &c. The hardware manufacture is one of the most important carried on in Great Britain; and from the abundance of iron, tin, and copper ores in this country is likely to remain so, provided the supply of coal be unstinted. We have no means of ascertaining the quantity manufactured for home use, but the export statistics give some idea of the extent of the trade. In 1883 the total value of hardware and cutlery exported from the United Kingdom was £3,755,501. The United States, Germany, France, Australia, India, and the colonies were the principal markets.

HARE is the common name of all the species, except the RABBIT, of the genus Lepus, the type of the Leporidæ, a family of Rodents. The genus Lepus, which contains nearly forty species, differs from all other rodents except the Calling Hares (Lagomys) by the possession of four incisor teeth in the upper jaw, the hinder pair being very small. The molars are twenty-two in number, five in each lower jaw and six in each upper, the last of which are very small. The molar teeth are destitute of true roots, and are formed each of two distinct laminæ. The hares have five toes before and four behind, an enormous *cæcum* five or six times larger than the stomach, and furnished within with a spiral lamina, which runs throughout its length. The soles of the feet are clothed with hair. The claws are long and narrow. The hares have long ears, a short tail, the hind feet much longer than the fore feet, imperfect clavicles, and the suborbital space in the skeleton pierced like network. Hares are found in nearly all parts of the world. They are all very timid animals and defenceless against enemies, except for their speed and the protection which the colour of their fur affords them.

The Common Hare (*Lepus timidus*) is familiar to every one in these islands, and it is to be met with throughout Europe, except in Norway and Sweden, Russia, and Ireland. The general colour of the fur is tawny-gray, inclining to brown on the back, and to a rusty tint lower down; underneath the belly and throat it is white, as well as on the inferior surface of the tail, which is usually directed upwards. The ears are longer than the head, and more or less tipped with black in different individuals. Respecting its habits, they are almost too well known to need any lengthened record. To the sportsman hares afford the excitement of the hunt, the amusement of the course, and the pastime of the gun. The hare feeds exclusively on vegetable substances, and causes terrible injury to young plantations, fields of early wheat, and other cereal crops. The habits of hares are for the most part nocturnal. During the day they rest in open fields and stubbles, and especially in grassy situations. For partial concealment and comfort, they construct superficial hollows in the soil, which are technically termed "forms." Hares are good swimmers when occasion requires. After their wanderings they return to their forms. Hares are very prolific, several broods being produced in a year. The female generally produces two young at a litter, but frequently as many as three, four, and even five, the leverets having their sight at the time of birth, and being able to shift for themselves at the expiration of about a month. The hare has never been known to breed in confinement. Crosses between the hare and the rabbit, called leporides, have been successfully produced.



Common Hare (*Lepus timidus*).

The Varying or Alpine Hare (*Lepus variabilis*) occurs throughout Northern Europe and Asia, and the mountainous regions of Southern Europe. It is the only hare found in Ireland. Like many of the northern fauna it changes the colour of its coat with the seasons. The fur, which is full and soft, is in summer gray, intermixed with silky hair of a yellowish-brown; the ears are tipped with black, and the under parts are light gray. The tail is white beneath and gray above. As the winter approaches, the fur gradually becomes white, except that on the lips and the tips of the ears, which remains black. In the mild climate of Ireland this change does not take place at all, and it is only partial in many parts of Scotland, where this hare is known as the blue hare.

Further north a distinct species occurs, the Polar Hare (*Lepus glacialis*). In this species the fur is quite white, except at the tips of the ears, which are brownish-black. The Polar hare resembles the rabbit in living in burrows, holes scraped in the snow. This hare has been found as far north as man has penetrated.

The American Hare (*Lepus americanus*) is tolerably abundant throughout the more wooded parts of the entire northern continent from which it derives its specific title. In form, size, and general appearance it very closely resembles our English rabbit, feeding on grass and various vegetable matters, and being particularly fond of willow bark. During the winter great numbers are destroyed on the banks of the Mackenzie River by the Hare Indians, who capture them with snares. These hares are also destroyed in great numbers by wolves, gluttons, foxes, hawks, and other animals, and form the principal food of the Canadian lynx. In the fur countries this hare becomes white in the winter. In the milder districts the ordinary grayish-brown colour is retained throughout the cold season. Several thousand furs are annually imported to this country, under the title of rabbit skins, but their value is scarcely sufficient to reward the trouble of exportation.

HARE-BELL. See CAMPANULA.

HARE-LIP, a malformation in which the human lip is divided in one or more places by clefts extending from its free edge towards its attachment. It has received this name from the resemblance it bears to the divided upper lip of hares and other gnawing animals, and is one of the most common of the malformations by arrest of development. Hare-lip may be single or double—that is, there may be one or two fissures. The one may be seated in the middle line of the lip, or opposite to the union of the two incisors with the canine teeth; if there be two, they will be found in the latter situation on each side. It may be simple or complicated with fissures of the gum or palate, which, being developed in an analogous manner, may be influenced by the same cause as the lips, though being earlier united they are less rarely affected.

The cure of hare-lip is important, not only for the uncouth deformity, but because sucking is prevented in infancy, and in later life the speech is affected. It is accomplished by cutting off quite smoothly the opposite edges of the fissure in its whole length, and then bringing them together and maintaining them in accurate apposition till, like the edges of a common wound, they have firmly united.

HA'REM (Arabian), the name given to those apartments in Eastern houses which are appropriated exclusively to women, and hence to the entire family of wives and favourites belonging to any one man. The word means "forbidden," because entrance to the harem is forbidden to any man but the master of the house.

HARE'S-EAR. See BUPLEURUM.

HAR'GREAVES, JAMES, inventor of the carding-machine and the spinning-jenny, was an artisan at Stanhill, near Blackburn, in Lancashire, where he was born. He and his family supported themselves by weaving and spinning, carried on in his own house, according to the custom of the time and place. In 1760 he invented the carding-machine as a substitute for the hand-cards previously used. In 1764 he contrived that kind of apparatus for spinning by machinery since known as the jenny, and made one with eight spindles, which was driven by hand. So strong was the prejudice at that time against the use of machinery in manufacturing, that it was necessary for Hargreaves to make and work his machines in secret. At length the unusually large quantities of yarn brought by his family for sale to the factory drew attention and suspicion upon him, so that a band of workmen broke into his house and destroyed his machinery and furniture, and he became the object of a persecution which compelled him to leave the neighbourhood. In 1768 he removed to Nottingham, whither he had been invited by a company of stocking-weavers to become the manager of a spinning-mill. Soon afterwards, in conjunction with a partner named Thomas Jones, he set up a factory at Hockley for spinning yarn for the hosiers, which he carried on with moderate success till his death in April, 1778, when his share in the mill was bought by his partner from his widow for £400. It will be thus seen that he died a comparatively poor man, and the only national recognition of his services to his country was the gift of £250 from the Royal Bounty Fund to his youngest and only surviving daughter, fifty years after his death.

HARI KARI or **HARA KIRI.** See HARRI KARI.

HAR'ICOT. See BEAN.

HARI'RI, ABU MOHAMMED AL KASIM BEN ALI, a celebrated Arabic author, was born at Bussorah, on the Tigris, 1054–55 A.D., and died September, 1122. Very little is known as to his early life, but the name Hariri means silk merchant, and refers to the occupation of his father, who was a man of wealth, and appears to have allowed his son to devote himself to literary pursuits. At the time of the Crusade led by Baldwin of Flanders he held the position of political intelligence agent, and some references to the Crusade are to be found in his works. His first literary productions, the "Delights of Grammatical Analysis" and "The Diver's Pearl," were devoted to a discussion of the niceties of the Arabic language; but his great work was the composition of the "Mákámat" ("Assemblies" or "Sittings"), a collection of fifty short tales or dramas, written partly in prose and partly in verse, which are of the very highest value to all students of the language.

According to one of the sons of Hariri the composition of this work arose from the circumstance that his father was one day seated in a mosque, when an old man, poor and travel-stained, entered, and in answer to the inquiries of the bystanders, narrated the story of the destruction of his native city of Edessa by the crusaders and his own personal troubles, in language of such force and elegance as to excite universal admiration. Hariri went home and wrote down the story, which, though the first written, now forms the forty-eighth of the series.

In the stories two characters are brought into contact, one a grave and dignified Arabian gentleman, El Harith, and the other a clever, amusing vagabond, Abu Seid, whose adventures and sayings form the staple of the stories. These contain a rich mine of proverbs, maxims, allusions to Arabic poetry, history, and tradition, idioms, phrases, and synonyms of the language. As an authority on the Arabic language this book ranks next to the Koran, and it has been valued so highly by the countrymen of the poet, that according to some it ought always to be written on silk, while others have said it deserves to be written in letters of gold. This book was not the first of the kind to be written, and it has been imitated very frequently, but it stands pre-eminent above all others in its wealth of learning, elegance, and the interest of the stories.

The "Mákámat" was published under the editorship of Silvestre de Sacy, with a commentary, in Paris in 1822, and a new edition, with notes by MM. Reinand and Derenbunj, was issued in 1853. A splendid translation into German was made by the poet Rüchert in 1826, and portions of the stories have been translated into English by Theodore Preston (London, 1850), and by T. Cheney (London, 1867).

HAR'LECH SERIES are the lowest beds of the CAMBRIAN rocks in Wales. The base of the beds is not seen, and as developed they attain a thickness of from 4000 to 8000 feet. They have yielded a tolerably abundant fauna, in which trilobites predominate, as Paradoxides, Plutonia, Microdiscus, Palæopyge, Agnostus, Conocoryphe; annelides, as Arenicolites; sponge, as Protospongia; brachiopods, as Discina, Lingulella; pterapods, as Theca. Many of the beds are also marked with ripples, sun-cracks rain-pittings, &c. They consist chiefly of purple red and gray flags, sandstones, slates, and conglomerates.

HAR'LEQUIN, one of the performers in modern English Christmas pantomimes. The name is from the

Italian *arlechino*, or the French *arlequin*, who was the jester or satirist of the early drama. The harlequin of the present day wears a tight dress covered with spangles, and represents the most respectable part of the pantomime. His office is to dance with the columbine and to frustrate the knavish devices of the clown.

HARLEY, ROBERT (EARL OF OXFORD), was born in London in 1661, of a family of note in the county of Hereford. He entered Parliament after the Revolution as member for Tregony, and afterwards sat for Radnor, professing for some time the Whig principles of his family. After a transition period, however, he went fairly over to the Tories. In the House which met under the administration of Rochester and Godolphin, in February, 1701, Harley was elected speaker by a great majority, and also in the next Parliament. He was a third time chosen to the same office, in October, 1702, and retained it till April, 1704, when he was made secretary of state. He is believed to have been principally indebted for this promotion to the good offices of Miss Abigail Hill, who, according to the Duchess of Marlborough, by Harley's management became Mrs. Masham, and in return exerted all her influence to attach the weak mind of the queen to Harley and his friends. In this state of things the Marlborough party began to seek a new support by inclining towards the Whigs. The struggle was finally decided against Harley by the public suspicion and odium to which he became exposed in consequence of the conviction of one of his clerks named Gregg for carrying on a treasonable correspondence with France. In the beginning of February, 1708, the Duke of Marlborough and Lord Godolphin intimated to the queen that unless Harley were removed they would leave her service; on this the secretary resigned, along with Mr. St. John (afterwards Lord Bolingbroke). Harley remained out of power for about two years and a half, at the end of which time Godolphin was dismissed, and Harley was appointed chancellor of the exchequer. The Duke and Duchess of Marlborough, and all their connections, were completely discarded both from office and from the queen's favour. Harley was appointed lord high-treasurer, created Earl of Oxford and Mortimer, and invested with the order of the Garter. The peace of Utrecht, concluded 5th May, 1713, is the event for which the administration of Harley is chiefly memorable. It was after this that the jealousy between the premier and Bolingbroke assumed the character of an open rivalry. Bolingbroke had now the art to gain the favourite, Lady Masham, and on the 27th day of July, 1714, the lord treasurer received his dismissal. The queen's death, three days after, put an end to the political existence of both Oxford and Bolingbroke. In August, 1715, both were impeached by the House of Commons. St. John made his escape to France, but Harley was committed to the Tower, and there he lay two years, when he was brought to trial before the House of Lords; but the Commons not appearing to prosecute their impeachment, the prisoner was acquitted. After this the Earl of Oxford lived in retirement, devoting himself to the society of scholars and men of letters, and to the accumulation of that valuable collection of books and manuscripts which he bequeathed to the British Museum, and which is called after his name. He died 21st May, 1724. Three disquisitions on financial and political subjects, said to be written by him, appear in the Somers Collection of Tracts.

HAR'LINGEN, a seaport in the province of Friesland, Holland, about 65 miles N.E. of Amsterdam. It is a flourishing port, has important commercial relations with England and Norway, exporting large quantities of butter and cheese and numerous animals. It has a population of 14,000, chiefly employed in commerce, refining salt, and making sailcloth and bricks. The town is protected from the inroads of the sea by a very large dyke 40 feet high. It occupies almost the same site as a city which was entirely swallowed up by an inundation in 1134. A new harbour was constructed in 1870–77.

HARMAT'TAN, the name of a hot suffocating wind which blows from the interior of Africa towards the Atlantic Ocean. The term is derived from the Fantees, a nation on the Gold Coast, where this terrible blast is the most prevalent. It occurs during the months of December, January, and February, and sometimes continues with unremitting violence for six or seven days. It takes its rise in the great desert of Sahara, and passes over Senegambia and Guinea to that part of the coast of Africa lying between Cape Verde (in N. lat. 15°) and Cape Lopez (in S. lat. 1°)—an extent of coast-line of nearly 2000 miles. Extreme dryness is the property of the harmattan, and during its continuance there is not the least appearance of moisture in the atmosphere. No dew falls, the grass withers, and all vegetation of a tender description perishes. The very furniture of the house and the panels of the doors crack and split from excessive heat and dryness, and the human body is unpleasantly affected by the drying up of the moisture of the eyes, nostrils, and mouth. Still, with all these annoyances, the harmattan is considered as highly conducive to health. During its influence fevers disappear, and the most malignant diseases are alleviated. The cause may be thus accounted for:—The wind immediately follows the rainy and unhealthy season on the African coast, and by its excessive dryness dispels the humidity from the atmosphere, and counteracts its baneful effects on the animal system.

HARMO'DIUS and **ARISTOGI'TON** (more accurately *Harmodios* and *Aristogeitôn*) were two Athenian citizens in the times of the sons of the great Pisistratus (Peisistratos), tyrant of Athens. These sons, Hippias and Hipparchus, wished to hold their father's sway without having his greatness, and the tyranny in the Greek sense (a despotism, possibly a truly noble government) became in their hands a tyranny in the modern sense. Hipparchus took a great fancy to Harmodius, who, however, was the "lover" of Aristogiton, in that curious fashion of the ancient Greeks not now intelligible to us moderns, and declined to leave those close ties of affection in response to the invitations of the prince. Hipparchus, furious at his courtesies being repelled, caused the sister of Harmodius to be pointedly dismissed, as unworthy, from a sacred procession in which she took part. This brought matters to a crisis, and all the long-growing dissatisfaction of Athens clustered round the exasperated youths, silently and with profound secrecy. Arms were, of course, not allowed by the tyrant, but at the Panathenaic festival the processionists were obliged to be equipped with spear and shield, and this therefore was the occasion seized upon. Hippias was marshalling the procession without the gates. One of the conspirators was observed to approach him, the others, fearful of being betrayed, precipitated the attack regardless of the guards, and fell upon Hipparchus, who was within the walls and near them. They slew him, Harmodius and others perishing in the contest, and Aristogiton being seized. The news flew to Hippias, who, without moving a muscle of his face, quietly told the citizens to pile their arms a few moments and follow him a short space off. His guards then secured the dangerous weapons. All suspected persons were seized, and Aristogiton died under the fearful tortures applied to make him divulge his associates. Leæna, the mistress of Aristogiton, shared his terrible fate, and was equally heroic with her lover. This was in 514 B.C., and though the tyranny of Hippias lasted four years longer (he was expelled in 510 B.C.), yet Athens always looked back to the pair of "lovers," Harmodius and Aristogiton, as the founders of the liberty of the republic. Their memory was enshrined in song and statue, and (*monumentum ære perennius*) in the pages of Thucydides.

A fine antique group of the two friends forms one of the treasures of the museum at Naples.

HARMO'NIA, wife of Kadmos (Cadmus), founder of Thebes, was, according to the Greek mythology, daughter of Ares and Aphrodite (Mars and Venus), and Kadmos received her from the hand of Zeus at the request of his patroness, the goddess Athena. All the gods came to the wedding and gave splendid presents. That of Hephaistos (Vulcan) was a wonderfully wrought necklace of precious metal. But as Aphrodite was his wife we cannot wonder that the god's gift to her daughter, who was none of his, was not as gracious as it seemed to be. It proved, indeed, fatal to all who wore it. Harmonia herself shared her husband's exile from Thebes, and became like him a serpent by the command of Zeus at the end of many sufferings, and so was taken up into Olympus. It passed into the hands of the ill-fated Theban family of Œdipus (Oidipous), and Polyneikes, son of Œdipus, gave it to Eriphyle, the wife of Amphiaraos, who fought with him and perished with him among the "Seven against Thebes."

Amphiaraos knew his fate, and charged his sons to destroy their mother, for being bribed by the necklace to drive him to it, as soon as they had grown up. Alkmaion, therefore, after he had taken part in the second attack on Thebes (by the *Epigonoi*, descendants and would-be avengers of the famous seven), murdered his mother, went mad, and was haunted by the Furies. He was at last purified by Phegeus, a prince of Arcadia, and married his daughter Arsinoe, giving her the necklace as a wedding gift. The Arcadians drove him away as a matricide, and after many wanderings he was protected by the god Achelous, who gave him his daughter Kallirrhoe. Kallirrhoe had heard of the famous necklace, and demanded it. Alkmaion therefore went secretly to Phegeus and asked for it, under the pretext that he wished to offer it to Athena at Delphi. It was discovered that he was only robbing Arsinoe for another, and Phegeus caused him to be assassinated. Arsinoe, who still loved him, protested, and was punished by being shut in a chest and carried away to Tegea, where she perished. But the sons of Phegeus, who had done this and held the necklace, perished later on at the hands of the sons of Alkmaion and Kallirrhoe. These last, so soon as they held the fatal gift, prudently dedicated it to Athena at Delphi, and it troubled men no more.

HARMON'ICA or **ARMONICA**, an instrument somewhat similar to that now known as musical glasses. It was invented by Benjamin Franklin. He saw an Irishman playing airs by the friction of his wetted finger on a row of drinking-glasses, which he tuned by putting water into each. Franklin mounted a number of glasses on a horizontal iron rod by means of a perforation in the bottom of each. The glasses partly fitted into each other without touching, and were tuned by grinding. In this way three complete octaves were got into a small space. The rod was then fixed in a box, and being set in revolution, the whole apparatus just dipping into some water beneath, the tones were brought out by applying a finger to the surfaces of the revolving wetted glasses. Gluck was a famous performer. The arrangement, however, was objectionable on account of its liability to get out of order, and none of its numerous admirers have ever succeeded in perfecting it. Bows were tried instead of fingers, and also rubbers worked by keys resembling pianoforte keys, so as to avoid the irritating vibration under the finger.

HARMON'ICAL PROGRESSION (or *Harmonic Proportion*). Quantities are said to be in harmonical progression when their reciprocals are in arithmetical progression. Thus the series

$$1,\ 3,\ 5,\ 7,\ \&c.,$$

is in arithmetical progression, increasing by a common difference (2). Their reciprocals, that is, the quantities they produce when they form the denominators of fractions whose numerators are unity, will of course be

$$1 \text{ or } \tfrac{1}{1},\ \tfrac{1}{3},\ \tfrac{1}{5},\ \tfrac{1}{7},\ \&c.,$$

and this series is said to be in harmonical progression.

So also the following series is in harmonical progression,

$$2,\ 4,\ 0,\ -4,\ -2,\ -\tfrac{4}{3},\ -1,\ \&c.,$$

because it is composed of the reciprocals of the arithmetical progression (difference $-\tfrac{1}{4}$),

$$\tfrac{1}{2},\ \tfrac{1}{4},\ 0,\ -\tfrac{1}{4},\ -\tfrac{1}{2},\ -\tfrac{3}{4},\ -1,\ \&c.$$

The meaning of the term harmonical is that the harmonics of a string are produced successively by half its length, a third of its length, a fourth, a fifth, &c., that is, by the reciprocals of the arithmetical progression, 1, 2, 3, 4, 5, &c. To work with harmonical progressions, the only feasible way is to consider the corresponding arithmetical progression according to the usual rules, and then convert the answer into reciprocals.

A line A B is said to be harmonically divided when two points, C and D, one within it and one on its continuation,

A C B D

are so placed that A C is to C B as A D to D B. In this construction C D is an harmonic mean between A D and B D, or A D, C D, and B D are as the reciprocals of terms in arithmetical progression.

HARMON'ICS are varieties of a musical tone caused by the division of the vibrations of the vibrating source. Thus if it is a column of air which is vibrating as a whole, in an organ-pipe let us suppose, and some cause (as overblowing or too great pressure of wind) disturbs this vibration, the column will split into two columns, each vibrating independently, and leaving the *node* or point of junction at the middle of the pipe almost at rest. But since a column half the length of another column gives a note an octave higher than this latter, the tone of our pipe at once springs up an octave. Performers on rude instruments of the pipe kind, such as the penny whistle, &c., find it very difficult to prevent this flying up to the octave. On perfect instruments, as the flute, &c., it is used as a means of extending the scale; for the entire compass having been gone through can then be continued with the same fingering an octave higher by putting greater pressure on the blowing.

The same result follows with a string in vibration. Let a violin string in full vibration be lightly touched just at its middle. The middle point ceases to vibrate; it becomes a node. The string now vibrates in two sections, but as each section is half the length of the whole string, and as a string of half the length of another yields a note when vibrating which is the octave above the note of this latter, so in our case the effect of touching the string at its middle is to drive up the tone by an octave. It also has a remarkable effect upon the quality of the tone, taking away all harshness from it, and leaving a beautiful fluty sweet tone. The Germans call the harmonics of a string "flageolet tones" (*flageolet-töne*).

The first harmonic, produced by the $\tfrac{1}{2}$ string, gives the octave, whose ratio of vibration is 1 : 2; that is to say, if c' be produced by 264 vibrations a second, c'' (the octave above) will require 528 for its production. The next harmonic is got by touching the string at $\tfrac{1}{3}$ its length, and this gives the Fifth above the first harmonic, the ratio of vibration of the Fifth being 2 : 3. The next harmonic is produced by touching the string at $\tfrac{1}{4}$ of its length, and is the Fourth above the second harmonic, ratio 3 : 4; and so on. In fact, we have here the same progression as for the *partial tones* of a *compound tone* as described in the latter portion of the article ACOUSTICS, and it is convenient to

number the harmonics like the partial tones therefore. Thus we call the prime tone 1, the first harmonic (an octave above the prime) 2, the next (rising by the interval of a Fifth) 3, the next (rising by the interval of a Fourth) 4, the next (rising by the interval of a Major Third) 5, &c., and the whole series comes out thus, each interval in the series being less than its predecessor:—

It will be observed that we get the Harmonics 2, 3, 4, 5, &c., by touching the vibrating string at $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, &c., of its length, and converting the point so touched into a node; that is to say, we force the string to vibrate in 2, 3, 4, 5, &c., sections. The series $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, &c., are reciprocals of the arithmetical progression 2, 3, 4, 5, and their peculiar progression has given the name to HARMONICAL PROGRESSION. It is also observable that while 2, 3, 4, 5, &c., pass from less to greater, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, &c., pass from greater to less.

A skilful horn player will blow all these harmonics one after the other (except perhaps the first, and even that can be obtained by a trombone player and with a special mouthpiece). The usual first note actually played with the C horn,—that is, the horn playing in the key of C—is the "second" harmonic, where the column of air vibrates in two sections and gives an octave *c* to the fundamental tone of the pipe. A slight extra pressure of the lip next makes it vibrate in three sections, giving *g*; again, a slight increase of pressure causes the column to divide into four sections, giving *c'*, the double octave. Further increase divides the column into five independently vibrating sections, and these give *e'*, and so for all the rest. The notes 7, 11 and 13, and 14 (the octave of 7) are not quite in accord with our diatonic scale, and have to be "managed." Ordinary horn players go with ease up to the twelfth and thirteenth harmonics, and it is in this way that they produce the varied tones of the instrument. See HORN.

The same thing precisely occurs with a string: a long thin string on a grand pianoforte will yield harmonics up to the twenty-fourth; that is, a little damper of very sharp edge being placed at $\frac{23}{24}$ of the whole length of the string, the string will vibrate four octaves and a Fifth above the prime tone. The prime tone is the tone given by the whole length of the string. This experiment requires the nicest possible adjustment, but harmonics of less height may be produced with the greatest readiness. Violinists use their harmonics with ease, giving very high fluty sounds with great facility and purity. Of course the sounds caused by damping the string at a *node* and sending it into harmonics are quite different from those which would be caused by *stopping* the string at the same point, with the one exception of the "second" harmonic, the octave. Consequently when a violinist wishes to play in harmonics he writes the passage in the corresponding stopped notes, and then, touching the string very lightly at the points indicated, instead of pressing it down on the finger-board as in ordinary playing, he gets the desired effect. Take as an example the following passage in harmonics for the violoncello:—

Played.

Effect. 8va . . . .

The above is a very usual way of signifying that harmonics and not stopped notes are to be used, namely, by putting a small circle over the notes, which is then touched and not thoroughly stopped. Another way of indicating harmonics is to write the passage in notes of a diamond shape but "open," like the semibreve and minim.

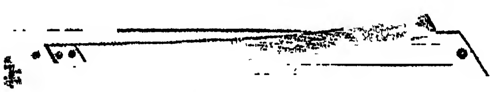
Beginners in acoustics invariably confuse the *partial tones* of a compound tone with harmonics, and yet nothing can be more distinct; for partial tones are simple tones, and harmonics are compound tones. A reference to the article ACOUSTICS will show that practically every musical sound is made up of a series of subordinate sounds, the lowest of which is called the prime, and the rest of which succeed one another at the relative distances given in the example above. This example serves as well for the succession of partial tones as for that of harmonics. All these partials together make up a compound tone, but each partial is itself a simple tone. Very few examples of simple tones (except partials of a compound tone) are known in nature. By suitable instruments called resonators partial tones may be discovered wherever present, and isolated, each resonator reinforcing one simple tone and one only. Now *primâ facie*, since harmonics are caused respectively by vibrations of the string (or of the column of air in a pipe) in one segment, in two segments, in three, in four, and so on, it would seem as if they should partake of the nature of the tone of the original string or column of air. And as this nature of tone, or *quality*, is due to a certain assortment of partials differing for each quality of tone (the partials of a fiddle being quite different in number and in relative intensity from those of a pianoforte, though both, as far as they go, follow exactly the same succession of intervals), it follows that the harmonics presumably have somewhat the same partials as the original string or pipe. Experiment finds that this is so; but at the same time the peculiar mode of production of harmonics greatly affects the inner relations of these partials, tending to annihilate differences, and therefore to assimilate the tones of various instruments. A violin played in harmonics is frequently almost indistinguishable from a flute.

From what has been said above it will readily be perceived that while the violinist only uses harmonics as a pleasant variation to his ordinary tone, the horn player (with the trumpeter, trombone player, &c.) uses nothing else—harmonics are his sole material. The flute player, with the clarionet, oboe, and bassoon players, has only one octave of natural notes; all the rest of their sounds are harmonics—first a series in the octave, then a series in the twelfth, then in the double octave. The clarionet skips the octave harmonic and blows up a twelfth as its first change. The organ usually contains one or more "overblown" stops playing harmonics. The "harmonic flute" is a favourite example. The violinist and the harp player produce also what are called *artificial harmonics* by stopping the string at a suitable point, and taking a harmonic on the string thus shortened. In this way any note can be readily obtained as a harmonic. The horn family in like manner can extend or shorten their tubes by slides or crooks, and so pass from one series of harmonics to another.

Finally, the harmonics of the human voice are the *falsetto*, usually painfully distinct in quality from the true tone in male voices, but a most valuable addition to the register of lady sopranos, and blending in them very fairly with the true voice.

HARMO'NIUM, a musical instrument which owes its origin to the invention, or rather the revival, of the *free vibrating reed*. There are many claimants to this invention, but the Chinese were undoubtedly acquainted with it

long before its introduction into Europe. The harmonium is usually about 3½ feet high, and the same in length; it has a compass of five octaves of keys, from C to c'''' or from F F to f''', the keyboard being placed on the top, immediately below the lid. Under the keyboard is the wind-box, inside which the different reeds are placed. The sounds are produced by wind furnished by means of bellows worked by the foot, and forced into the air-chest, and thence into the wind-box. This latter occupies the whole width of the instrument, and is separated longitudinally into two or more compartments, according as there are two or more sets of reeds or vibrators. A complete set of vibrators fills each of these compartments. It follows that all the vibrators corresponding to one key of the keyboard are in line across the instrument, and the keys are furnished with as many pallets as there are rows of vibrators. Let there be four rows, then each key has four pallets, and when the key is pressed down these four pallets are opened, and the four vibrators are ready to sound. But the wind is only admitted to those compartments of which the draw-knob or "stop" has been drawn out. If only two stops are out only two vibrators play, although all four pallets are open, for there is no wind in the other two compartments. The wind is forced through the vibrators by the rising of the movable floor of the wind-box, which is pressed upwards by powerful springs. In the American organ the reeds are turned upside down, and the bellows exhaust instead of pumping. The wind is sucked through the reeds, and not blown through as in the harmonium. The tone of the American organ is much sweeter and more even, but not nearly so powerful as that of the harmonium. The free reed used in the harmonium is formed of a brass frame containing a narrow rectangular slit, at one end of which a thin elastic spring of the same metal is fixed. This tongue is a little



Harmonium Reed.

smaller than the opening, so that when a current of air is projected against it, it yields to let it pass; but its elasticity forces it back into the opening, and its momentum carries it to an equal distance on the other side. The spring at the free end is permanently bent a very little outwards. The vibration produces a musical sound, so long as the current of air is maintained. The vibrations of the reed depend for their rapidity on the thickness of the tongue at the free end in proportion to its length. If thick at the free end and thin at the fixed, the vibrations will be comparatively slow and the resulting note deep; if the tongue be thin at the free end and thick at the fixed, a higher note will be the result; consequently the method of tuning the vibrators is to scrape them at the root to flatten them and at the tip to sharpen them. The quality of sound is also affected by the breadth of the vibrating part of the reed and the shape of the aperture in the wind-chest covered by the valve. The sizes of the reeds differ according to pitch, from 4 inches to half an inch in length. Any note may be made loud or soft by varying the pressure of the wind, and advantage may be taken of this peculiarity to effect a beautifully expressive swell or diminution in the sound. Only a slight alteration is caused in the pitch of the sound; practically its volume is merely increased or diminished.

When, by the action of the current of air from the wind-box, the tongues are first caused to vibrate, they do not at once reach their full vibration. It has, however, been overcome in the case of the harmonium by the invention of what is known as the *percussion* action. In this the moment the key is pressed down a small hammer rises, strikes the reed, and sets it in full vibration, which is then continued by the escaping wind. But as this produces a banjo-like sound in itself, the alteration of quality is almost too decided to make it satisfactory for constant use, though valuable as a variety. Manufacturers have therefore overcome the defect in other ways, modifying the wind, rolling the tongues to a point of great elasticity, &c.

Harmoniums are made of various sizes, from one row of reeds (or vibrators as they are now called) to four or more rows; each row is divided near the middle, between an E and F, and each half has its separate draw-stop. Other stops are introduced which more or less vary the tone of the instrument. By drawing out the *expression* stop there is an arrangement by which the power of any given note may be increased by pressing more forcibly on the foot-board; and in some instruments there is a draw-knob marked *expression à la main*, by drawing out which the power of a note may be increased simply by pressing strongly upon the key. There are also the *tremolo*, the *sourdine*, and the *celeste*, for modifying the tone of certain stops. Some harmoniums are made with two or more rows of keys, and others with organ pedals also.

The principle of the harmonium was invented by Grenié in 1810, who called it *orgue expressif.* Debain in 1840, at Paris, was the first to use the word harmonium, and the first to overcome the practical manufacturing difficulties. Alexandre followed swiftly with the expression stop and the percussion. Later improvements are English. Dawes' melody attachment gives prominence to the top notes of any chord (1846). Tamplin thought of the double touch in 1855, &c.

Harmoniums may now be obtained at prices varying from £4 upwards. An immense number of them are continually being sold in this country, and find their way into thousands of homes where a pianoforte is too expensive a luxury. They are not at all likely to supersede the latter instrument. On the other hand, they form an agreeable combination with it when played together, as by their power of holding on the tone they give a delightful variety to the transitory sounds of the pianoforte. Those who can afford it, therefore, usually have the two. Sometimes both instruments are combined in one case and worked by one set of keys, as in the "orchestral pianoforte." Harmoniums of the larger kind are especially valuable for accompanying psalmody in temporary places of worship, or where an organ cannot be afforded.

HARMONY, in its broadest definition, is the simultaneous sounding of musical notes—notes *in combination*, just as melody is notes *in succession*. The material of harmony at once therefore divides itself into CONCORDS and DISCORDS, and the nature of these is treated of under their respective headings. Further, the successive combinations of notes in a harmonized piece of music may be regarded vertically, as chords succeeding one another, or horizontally, as several melodies running simultaneous careers. The construction of such concurrent melodies, each to a certain extent complete in itself, but altogether forming a harmonious whole, was the earliest form of harmony, and was called first ORGANUM (Diaphony), then Discant or COUNTERPOINT, both forms being described fully elsewhere. Comparatively recently the freedom and individuality of independent parts have given place to the massing of chords; and the separate parts of the harmony, losing most of their own interest, exist only as portions of the whole mass of sound, being often unintelligible, that is, conveying no musical idea apart from the rest of the chord. It is this view of harmonized music which forms the main subject of the current treatises on harmony. These treatises usually contain a consideration of INTERVALS, an account of KEYS and SCALES, a collection of laws of PART WRITING, and definitions of concords or COMMON CHORDS and their inversions (together with CHROMATIC

CONCORDS), and of DISCORDS and their inversions and resolutions. To these articles the reader is referred, as well as to those headed AUGMENTED SIXTH, CONSECUTIVES, PASSING NOTES, and SUSPENSIONS. The discords of the SEVENTH, the ELEVENTH, and the THIRTEENTH are also separately treated, as well as the general view of them taken in the article on DISCORDS. The exercises in part-writing in text-books on harmony usually take the form of chords or harmonies above a given bass, and the chord desired is expressed by a figure written above or beneath the bass-note, as described in FIGURED BASS. So universal is this practice that it was till lately usual to style treatises on harmony "treatises on thorough bass" (*i.e.* figured bass).

At first sight the material of harmony seems unlimited, since a number of concords and discords and inversions of each of them can be constructed on every note in music. But when it is found that all these sounds are resolvable into keys, each containing only twelve sounds in our system of music (though in some systems, as the Arabian, they may contain more, and in others, as the Chinese, they may contain less), the mass of sound becomes less formidable. Finally, Dr. Alfred Day showed that if one takes a succession of Thirds from a note one arrives in seven movements at the double-octave or Fifteenth (1, 3, 5, 7, 9, 11, 13, 15), when of course the series simply begins over again at a different pitch. Let the Third and Eleventh be always major, the Seventh always minor, the Ninth and Thirteenth either major or minor as preferred, and we have in this series all the intervals of the natural scale of any key when we start from the Dominant of that key. To obtain such a series from the Tonic and from the Supertonic accidentals are necessary (that intervals of strictly the same "quality" may be secured). The three series, with Dominant, Tonic, and Supertonic as their respective basses, give all the notes of the key; and all the possible chords in it will be found in one or other of these series except the AUGMENTED SIXTH, which, as elsewhere explained, is made up of notes from two series. The following are the three series in the key of C:—

Dominant.	Supertonic.	Tonic.
E♭ or E	—	—
—	D	—
C	—	C
—	B♭ or B	—
A♭ or A	—	A♭ or A
—	G	—
F	—	F
—	E♭ or E	—
D	—	D♭ or D
—	C	—
B	—	B♭
—	A	—
G	—	G
—	F♯	—
—	—	E
—	D	—

Comparative view of the three great series of Fundamental Discords.

Adding these notes all together we get the full chromatic scale for the key, in this instance C, viz. C D♭ D E♭ E F F♯ G A♭ A B♭ B C. If, then, we master the resolutions of the discords in any one of these series we have the key to all the intricacies of harmony. This is the truly grand discovery of Dr. Day [see DAY, ALFRED, M.D.], and has revolutionized the whole art. The rules governing the resolution of the several discordant notes, and the general rules governing the resolutions of the respective series as a whole, are each of them given fully in the article DISCORDS. Finally, the historical development of harmony from the sole use of the great perfect concords to the keener added delight of the less perfect consonances of the Third and Sixth (in spite of the opposition of the church, even rising at times to bulls from the pope himself), then onwards with a timid use of the dominant Seventh to ever sharper and sharper discords added by successive ages, until we have arrived at the present absolute liberty to use any combination of notes whatever, provided we resolve all the discords properly, is sketched as far as our limits allow under the article MUSIC.

HARMONY OF THE GOSPELS. In the article GOSPELS it was observed that certain real or apparent discrepancies and divergencies exist in the narratives of the four evangelists, and that in the first three of them the chronological order of events does not appear to have been strictly regarded. This was observed very early in the history of the church, and as early as the second century an attempt was made to weave the items given by the different evangelists into one continuous narrative in the "Diatessaron" of Tatian, and according to St. Jerome a similar work was undertaken about the same time by Theophilus of Antioch. The first proper harmony, however, was that compiled by Ammonius Saccas of Alexandria, who arranged the parallel passages in four columns, and his work formed the basis of the elaborate "Ten Indexes" of Eusebius. The interest of the subject has led many Christian scholars to attempt the task of harmonizing and arranging the materials afforded by the evangelists; but while a synoptical view can easily be presented, a precise chronological arrangement presents difficulties that are practically insurmountable. Since the revival of scriptural study brought about by the Reformation nearly 200 attempts to compile a complete gospel harmony have been made, but there are only very few that have obtained any wide acceptance among scholars. One of the latest and best is that of Tischendorf, published in 1851. The one most generally used in England is published by the Religious Tract Society, and is based upon the labours of Dr. Robinson (1845).

HAROLD I. (*Harefoot*), Danish King of England, was the son of Canute the Great (*Cnut*) by his first wife, Ælfgifu, daughter of Ælfhelm, earl of Deira. At the death of Canute in 1035 Swegen inherited Norway, and his brother Harold should have had England, while Harthacnut, son of Canute by Emma, widow of the English King Ethelred (or Æthelred), took the remaining kingdom of Denmark. But Harthacnut, though in Denmark at the time, had a strong body of partisans in England, and eventually Harold yielded Wessex to him, taking all north of the Thames for himself. The sons of Ethelred, the Athelings Alfred and Edward, still lived, and indeed Edward was afterwards to reign as Edward the Confessor. They were safe with their mother's people in Normandy. In 1036 Alfred attempted an invasion of Wessex, perhaps because his mother Emma ruled it as regent for her son Harthacnut, who still remained in Denmark. Emma and Earl Godwine staved off the attack, and Alfred falling into Harold's hands, whether with or without Godwine's help, the king had him barbarously tortured, mutilated, and killed. But the natural horror at such cruelty seems to have been swallowed up in appreciation of the readiness of Harold to defend the land, in contrast with the continued absence of Harthacnut. Wessex therefore declared for Harold; Emma was driven oversea and took refuge in Flanders, and Harold reigned alone (1037). He died in 1040, and was succeeded by Harthacnut.

HAROLD II., the second of the sons of Godwine, earl of Kent, makes his first appearance in political history after the death of Canute as a supporter, in concert with Queen Emma, of the succession of Harthacnut. Under Edward the Confessor Harold became earl of East Anglia, his father Godwine holding Wessex, and his brother Swegen

the great earldom of the west. Leofric, earl of Mercia, was the only substantial opponent of the all-powerful Godwine family. Harold's sister, Edith, was the queen of the monkish King Edward. In 1051 Edward's partiality for the Norman friends of his youth rose to a pitch so dangerous for the welfare of the kingdom—every possible post being in the hands of the Normans—that the people, headed by the Godwines, rose in rebellion. But at a witan the other nobles fell away from Godwine, and he was banished. He went to Bruges with his wife and three sons. Harold and another son went westward, but good Bishop Ealdred, sent after them, made no haste, and they got clear away to Ireland, where Dermot, king of Leinster, received them kindly. Queen Edith was imprisoned and her own property confiscated, and for a time the Frenchmen had it all their own way, and William, duke of Normandy, came on a long visit. Earl Leofric's son, Ælfgar, was rewarded with Harold's earldom of East Anglia. In 1052 Harold and his brother made a descent upon the southern coast of England, and shortly afterwards were joined by Godwine; and it was not long before they were able to sail up to London and demand justice. The people refused to raise a hand against them, and the half-Norman king had not only to submit once more to English ministers, but the tribe of Frenchmen were swept out of the land, Harold again assumed the earldom of East Anglia, and the queen and all the family were restored. For the next fourteen years, the last time for some centuries, England was ruled by Englishmen. When Earl Godwine died in 1053 Harold became Earl of Wessex, and gave back East Anglia to Ælfgar; from this time to the Conquest Harold may be regarded as the foremost man in England, and so great was the fascination of his character that he seems even to have won the rare affection of the king himself. He built the famous Waltham Abbey, to contain a wonder-working rood (crucifix), and founded by it a college of twelve secular priests to teach those who came there; and while this was being carried out he made a pilgrimage to Rome. On the death of Earl Leofric, Earl Ælfgar, his son, took his earldom of Mercia (1057), yielding his own government of East Anglia to Harold's brother, Gyrth. Another brother of Harold's was intrusted with Kent and Essex, and Harold himself took in exchange the Welsh border in addition to his earldom of Wessex. The remaining brother of Harold's, Tostig, was Earl of Northumbria (1055). All England, save Mercia, was Harold's, and with it the hearty goodwill of the people he ruled. And further, the last child of Edmund Ironside dying about this time, and the king being childless (probably by his own choice, for he was at heart a monk), the royal line of Wessex was manifestly dying out. Harold was marked out as the future king, although there were rumours that Duke William of Normandy, whose exploits had gained him the surname of "the Great," had been promised the succession by Edward when he had visited him during the exile of the Godwine family. The succession of course lay with the witan, but doubtless the recommendation of the saintly king would prevail to sway their decision.

About 1055 Earl Ælfgar was outlawed on a charge of treason, on which he fled to Ireland, but speedily returned with a force of Danes from that country, and of auxiliaries from Wales, to levy war against the king. A contest was prevented by a negotiation which restored his earldom to Ælfgar. Harold meanwhile, as the king's commander-in-chief, turned to chastise the Welsh for the aid they had given to the revolt; and a series of hostilities with that people commenced which did not finally terminate till 1063. It was about two years after this that Harold was shipwrecked on the coast of Ponthieu, where he was immediately seized by the Earl Guy, and on the demand of William, duke of Normandy, delivered over to that prince. William did not permit his prisoner to embark for England till he had compelled him to take a solemn oath that he would do everything in his power, on the decease of Edward, to promote the duke's succession to the English crown. On the death of Edward the Confessor (5th January, 1066), who had named Harold for his successor, he was elected king, and next day solemnly crowned by the Archbishop of York, a few hours after the interment of the late king.

For more than half a year Harold was left to occupy the throne. Two foreign enemies, however, at length assailed him nearly at the same time. His brother Tostig, having formed a confederacy with Harold Hardrada, king of Norway, sailed round at the head of his fleet of sixty vessels to the mouth of the Tyne, where he was joined about the beginning of September by Hardrada, with a navy of 300 sail. The invaders had made themselves masters of the entire province of York before Harold came up. On the 25th, however, he engaged them at Stamford Bridge, on the Derwent, when both Hardrada and Tostig fell, and the English king obtained a complete victory. Only three days after this the Duke of Normandy landed at Bulverhithe, between Pevensey and Hastings, on the southern coast, with a mighty armament, which he had spent eight months in fitting out. Harold did not gain sight of the Norman camp till the 13th of October. On the morning of the following day the battle began at a place then called Senlac (now Battle), about 9 miles from Hastings. The issue of this memorable engagement was the complete defeat of the English, after Harold himself had fallen, pierced through the eye by an arrow. This victory gave the crown of England to the Duke of Normandy, by whose descendants it has ever since been worn.

HAR'OUN AL RASCH'ID, or *Harun er Rashid* (Aaron the Just or the Orthodox), the famous Caliph of Bagdad, was born at Rei, Persia, in 763 or 765. The fifth and the most renowned of the ABBASIDES, he succeeded his elder brother, El Hadi, in the caliphate in 786. He had previously been greatly distinguished for his success in arms, having when only sixteen, in a war against the Byzantine Empire, struck such terror into Constantinople as to induce the Empress Irene to pay a yearly tribute. Some insurrections which broke out on his accession were speedily put down, and under the able administration of the Barmecide Yahya and his sons, the empire reached a high pitch of prosperity. Although its boundaries were not extended, the vast dominions were kept under orderly rule and united to each other by trade and commerce. Tribute poured in from all quarters, and the city of Bagdad became one of the most flourishing of the cities of the East. Haroun, who was himself a poet and a man of letters, gave generous encouragement to scholars, poets, and musicians, and no Eastern ruler ever gathered more of such men around him. It is said he forced the Emperor Michael III. to send him yearly a tribute of Greek books, and according to some old European historians he kept up friendly relations with Charlemagne. The latter tradition, however, is now generally discredited, and the celebrated nocturnal rambles taken in disguise through the streets of Bagdad, which are familiar to the readers of the "Arabian Nights Entertainments," are not mentioned by authentic historians. Towards the close of his reign he became jealous of the Barmecides, and in 803 he ordered them to be massacred, not even sparing his favourite Jorafer or his own sister, whom the latter had secretly married. The destruction of these able administrators threw everything into confusion, and revolts broke out in several parts of the empire. One of these in Khorassan was of so formidable a character that he resolved to march against the rebels in person; but he was seized with a fit of apoplexy when he had reached the town of Tus, and died there in March, 809. While there seems but little foundation for the stories which tell of his liberality,

wisdom, and good humour, there is no doubt that his reign marks the golden era of the caliphate of Bagdad. See Gibbon's "Decline and Fall of the Roman Empire."

HARP, a stringed instrument of the greatest antiquity, is spoken of in the oldest writings, and depicted in the most ancient sculptures that we still possess. Whence the name comes that we know it by in England no man can conjecture. The Old English form was *hearpe*, and the Dutch and modern English get *harp* from this, while the German has *harfe*. The Norse tongues have the same root. On the other hand we have Italian *arpa* and French *harpe*. Skeat suggests ("Etymological Dict.") that it may be perhaps allied to the Latin *crepare*, and so mean "the sounding;" but this is merely a guess, little better than the derivation of Du Cange, who brings the word from the town of Arpi, in Italy, where, he absurdly asserts, the instrument was invented. It is difficult, therefore, to avoid the conjecture that the harp is an indigenous instrument, and that the French and Italian names are due to the fame of the northern harpers of early times. Certainly the Greek *epigoneion* and *simikion*, the Hebrew *kinnor*, the Phœnician *nebel*, the Assyrian *azor*, the Chaldee *sauteer*, and the Egyptian *bouna*, are names as unlike our harp as they are unlike each other; and it is quite unlikely that we derive the instrument from any of these sources.

But although the name is as yet obscure, the origin of the harp itself is self-evident; and we are not surprised at its having occurred independently in so many places. Any bent stick, like the *nanga* of the negroes, would suffice to render permanent the twang which every savage must have long heard and loved as he played his bowstring. Such a bent stick could give room for but one or two strings, and the next step was, therefore, to join two arms at a large angle, so that with the longest string the instrument became of a triangular form, and could bear many strings of various pitches, sharpening as they proceeded nearer to the angle and became shorter. These arms were soon made more beautiful by being curved, and more sonorous by being hollowed out. In this manner we get a soundboard, as shown in the well-known ancient Assyrian bas-reliefs, where the tension bar or tuning bar is held horizontally level with the performer's waist, and the great soundboard slants upwards and forwards at an angle, its highest corner being in front of the player and considerably above his head. The strings are of course vertical. The ancient Egyptian harps have their soundboard as the lower arm, and their tuning bar as the upper arm, somewhat like our modern harps. The oldest Egyptian form is the simple bow-shaped instrument, all in one curve, but later forms (though still of immense antiquity) are more triangular, and stand on a base much as our harps do.

Both these ancient forms of harps have no front pillar, and their tone cannot therefore have been very powerful, as any attempt to increase the strain of the strings, and so obtain greater brilliancy, would have broken the instrument. Besides, the tuning was not by pins, but by the twisting of the strings, strained by the hand several times round a tension bar, the long fringed ends of them shown clearly hanging loose in the Assyrian examples.

The earliest western harp we have is the very ancient Irish harp, of unknown antiquity, examples existing as old as the ninth century. The form of it is familiar to us in one of the quarterings of our Royal Standard. The body or soundboard is vertical, the tuning frame extends forward in a graceful curve, rather descending, and the strings are therefore strongly sloped backwards towards the performer, the whole instrument being held in a vertical plane. But the great feature of the Irish harp is the first appearance of the front pillar, which in this case was somewhat curved. Directly the tuning bar (now fitted with pegs) was thus held firmly apart from the soundboard, the danger of over-tension was obviated, and stronger strings more tightly stretched could be used. The strings of the Irish harp were of brass, two to a note, and in playing them the performer allowed his nails to touch them for still greater sharpness of tone. Vincenzo Galilei (father of Galileo), writing in 1602, distinctly attributes the Italian harps of his day to an Irish origin, and (in ignorance of what is so familiar to us from our Egyptian and Assyrian discoveries) he therefore attributes the invention of the instrument to Ireland. Probably he is right, but our contention herein is that the harp was invented in twenty different countries. Not only Italy, but also Wales adopted the Irish harp, and in Welsh hands the instrument changed much. It became larger, and therefore richer in tone; it received gut strings instead of wire, and gained thereby the delicious soft throbbing sound (produced with the tip of the finger, not the nail), instead of the metallic twang of its original. Further, it had three rows of strings, the two outer rows being in unison, the inner row giving the chromatic semitones—the sharps and flats. The older examples have the Irish perpendicular body; modern Welsh harps adopt the usual modern form, but retain the three rows of strings. The Welsh love for the harp was intense. It became not only the national instrument, but the test of a liberal education. No one was to be held of gentle birth who could not play the harp. A slave was forbidden to touch the harp, and none but gentlemen might possess one. In their laws we find that a harp may not be seized for debt. A gentleman without a harp seemed to them as a soldier without his shield did to the Greeks—eternally disgraced, and scarcely distinguishable from a slave.

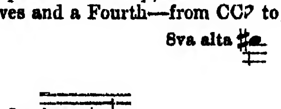
The harp of mediæval times, so dear to romancers, is well known to us from illustrations in manuscripts. The body or soundboard again slants, as in the later Egyptian models, so that the instrument stands on the floor and the strings are vertical. But the pillar is adopted from the Irish harp, and for centuries retains the somewhat bent form of the original. Examples of this form are known even in MSS. of the ninth century. These harps gave the scale of the white notes of a pianoforte (the diatonic scale), and had only one string to a note. Where, therefore, the Welsh harpist could modulate at his will by means of his chromatic third strings, the mediæval English harpist was tied to the key in which he had tuned his harp at the outset. The great respect paid to the early English harpist, who was sure of a warm welcome and of personal safety wherever he went, even among foemen, is well known to all. By help of the harp Alfred the Great penetrated into Guthrum's camp: so says the legend. Whether true or not it shows the popular estimation of the instrument. Rahere, harper to King Henry I., was wealthy enough to endow the priory and hospital of St. Bartholomew (which still remains at Smithfield), himself becoming first prior.

It was soon discovered that by pressing the string with the thumb while plucking it with the finger a note might be shortened, and therefore sharpened. In the beginning of the last century this knowledge was turned to account by German makers, and metal crooks were used to pinch the string, the performer holding the crook with the hand which was not playing. This deprived him of one hand, and the idea of turning these crooks by the feet, by means of a long connecting rod carried up through the front pillar, was hailed with great satisfaction. The pillar now, therefore, became straight. This invention was brought out in 1720 by Hochbrucker of Donauwörth, in Bavaria. It at once gave to the harp the possibility of becoming a perfect orchestral instrument, without the almost insuperable difficulties of the Welsh triple-stringed arrangement. This perfection was actually achieved by Sebastien Erard of Paris, who, after a long series of experiments, produced the double-action harp in 1810. The old crooks are replaced by revolving studs carrying two pins, between which the string passes, and worked by

concealed mechanism within the tuning frame, the mechanism set in action by pedals operating by connecting rods through the hollow front pillar. The first action of the pedal is to twist the stud round so that the two small pins, which when at rest lay in a diagonal line (from N.E. to S.W., as one might say on the compass), so that they did not touch the string, now lie vertically and clip the string firmly at a point just fit to give it a rise of a semitone in pitch. The second action of the pedal brings another row of studs into operation beneath the first, and far enough down the string to clip it at a second semitone's length, raising the string an entire tone from its open pitch. The harp is tuned in the key of C♭—that is, with every note flat; if all the upper studs are turned—that is, if all the pedals are put down to their first notch—it is of course put into C, with all the notes natural; and if all the lower studs are then turned in addition by all the pedals being put down to their second notch, it is put into the key of C♯, with all the notes sharp. There are seven pedals, each of which acts upon all the notes of one name. For instance, the first pedal raises all the F♭ strings to F when put down to the first notch, and all the F strings to F♯ when put down to the second. The harp being, as said, in the key of C♭ to start with, it is put into the key of G♭ by the first action of the F pedal, since the key of G♭ differs only from C♭ in having an F♮. The first action of the next pedal sharpens C♭ to C♮; therefore, with both these pedals in their first notch we get all the notes flat except C and F, that is to say, we are in the key of D♭. The successive keys with the first action of the pedals are, therefore (open), C♭ (1 pedal), G♭, 2 D♭, 3 A♭, 4 E♭, 5 B♭, 6 F, and 7 C♮. All the seven pedals are now down to their first notch. Leaving them so, and beginning again with the first pedal driven down to its second notch, we get F raised to F♯, that is to say, we pass from the key of C to the key of G. The successive keys with the second action of the pedals (all the other pedals remaining at their first action) are therefore 1^2 G, 2^2 D, 3^2 A, 4^2 E, 5^2 B, 6^2 F♯, 7^2 C♯, all the pedals now being down to their second notch. A slight sideway motion of the foot releases a pedal from its notch, and a spiral spring beneath it carries it up to its open position. (Single-action harps exist, the open key of which is E♭, but the difficulties of the performer are much increased by the imperfection of their mechanism, which can only affect the strings to the extent of one semitone. Some keys are practically unplayable. Single-action harps have not been manufactured for over half a century.)

It is evident, then, that the fingering of the harp is the same for all keys, that it is indeed a transposing instrument, and that pieces with numerous accidentals are unfitted to it.

The compass of the harp, as now used in the orchestra, is six octaves and a Fourth—from CC♭ to *f*♯''''.



Its most effective use is in the long sweeping arpeggios which give such magnificent colour to the scores of Gounod. The harp is also a very favourite instrument with Wagner, and Mendelssohn uses it, especially in "Athalie" and "Antigone," with peculiarly fine results. Berlioz has some extraordinary passages for it in his "Faust." Its very distinctive and penetrating character of tone renders it invaluable to the composer as a means for varying colour, for it is like no other instrument we have. Consequently it is largely used in the modern orchestra.

The rage for the instrument early in the present century was quite phenomenal. Every young lady was expected to learn the harp, regardless of sore fingers or natural distaste. But the greater effectiveness and facility of the pianoforte, as it improved, drove the harp out of the drawing-room, and it is now hardly ever heard except in the orchestra. The non-musical young ladies are not benefited thereby, as they have but changed the drudgery of one instrument for that of another. As a fashionable toy the harp had indeed great advantages of its own; finely tapered fingers, a flexible wrist, a shapely arm, a graceful figure, and a small foot were displayed by their fortunate possessors without blame, for the necessities of the instrument required it. In this respect the contracted chests and rounded shoulders of our pianists are a lamentable change for the worse.

HARP SHELL (Harpa) is a genus of GASTEROPODA, belonging to the family Olividæ. The harp shells, from the richness of their colours and the elegance of their forms, are much sought after by collectors. They are swollen ventricose shells with a large aperture and a small spire. The surface of the shell has a number of longitudinal ribs occurring at regular intervals, like the strings of a harp. The harp shell has a very large foot, which is divided into two portions. The anterior half is broad, but the posterior portion is elongate, terminates in a sharp point, and is nearly as long as the whole shell. It is so

The Many-ribbed Harp (*Harpa imperialis*).

disproportionately large indeed that it cannot be quickly withdrawn within the shell. The animal therefore has the power, when suddenly attacked by an enemy, of spontaneously detaching this hinder portion, by pressing it firmly against the lip of the shell, or by means of a sudden contraction, and thus enabling it to withdraw the rest of its body within the shell. It possesses the faculty also of reproducing the lost portion after a time. There is no operculum, as such an appendage would be of no use to the animal, since it would be separated by the rupture of the foot. Twelve species of this genus are known, all from tropical seas. The Many-ribbed Harp (*Harpa imperialis*) is one of the rarest and most beautiful species.

HARPER'S FERRY is a decayed town in the United States, 50 miles N.N.W. of Washington. It is in the state of Virginia, at the junction of the Shenandoah with the Potomac. It surrendered to the troops of the confederacy during the Civil War, on the 15th of September, 1862. It is celebrated as the scene of John Brown's abolition raid in 1858. [See BROWN, CAPTAIN JOHN.] A flood greatly injured the town in 1878. The population is 2000.

HAR'PIES (Gr. *harpazo*, I seize), in mythological history, a kind of winged monsters, with faces and busts like women, bodies like vultures, and hands and feet hooked, with claws like the talons of a bird of prey. They are often mentioned by the poets under the names of Aello, Ocypete, and Celeno; and are noticed in the third book of Virgil's Æneid as having plundered Æneas during his voyage towards Italy, and predicted many of the misfortunes

which accompanied his journey. The Harpies are undoubtedly the personification of the violent wind which snatches up and defiles things in sudden storms.

HARP'SICHORD, a keyed musical instrument, in form the same as the grand pianoforte, but smaller, strung with steel and brass wires, two to each note, which were struck by *jacks*, armed at their sides with small pieces of quill, acting as plectrums, and thus made to render a brilliant but somewhat harsh sound, wholly unlike that produced by the hammers of the pianoforte. As the witty remark happily hits it off, its tone is "a scratch with a sound at the end of it." When the jacks rose between the strings the latter were twitched by the quills which stood out from the jacks. In harpsichords with two strings to a note the jack had a quill on each side, and rose between the two strings, so as to set them both in vibration. The string was therefore not struck, but was attacked much more nearly like the harp—by plucking. Stops, swells, and double rows of keys were occasionally employed to modify the power of the instrument. One of Handel's harpsichords has two rows of keys—the lower with two strings to a note, the upper with but one string; a stop couples the two rows of keys together to produce a fortissimo when required. The tone of the harpsichord is capable of much more expression by touch than that of the pianoforte, and many composers long preferred it on this account. The harpsichord came into use in England in the seventeenth century, but it is now entirely superseded by the PIANOFORTE.

HAR'PY (*Thrasætus harpyia*) is a large bird of prey belonging to the family FALCONIDÆ: it is usually considered to be an eagle, but some find its nearest allies in

Harpy (*Thrasætus harpyia*).

the buzzards. The harpy is a native of Mexico, Guiana, and other parts of the hotter regions of America. It is stated to be a solitary bird, frequenting the thickest forests, where it makes the sloths its prey. It also destroys fawns and other quadrupeds; and it is further said that when wounded this bird does not hesitate to attack its human enemies. The harpy eagle soars not aloft like the golden eagle, but threads the mazes of the forests, intent upon the sloth clinging to the branch, or the monkeys gambolling amidst the foliage; its wings are not formed for exalted flight, and its general plumage is lax and owl-like. In strength of talon it is unequalled. The harpy is distinguished from other eagles by having a very strong beak, undulated at the margins, and very greatly hooked at the tip; the wings are short, scarcely reaching the base of the tail, which is long; and the feet are very stout, the tarsi reticulated and the toes scaled in front. The head in this fine bird is clothed with large rounded feathers, which can be raised at pleasure to form a sort of crest. The head is of a light slaty-gray, with the crest dull black. Below the crest the whole of the back and wings, together with a broad collar round the fore part of the neck, are black, each of the feathers of the back terminating in a narrow transverse somewhat lighter streak. The under surface, from the breast backwards, is pure white. The plumage of the legs is white, with blackish transverse bars. The tail has four transverse black bands, of about equal breadth with the four alternating whitish or ash-coloured species; the tip is light ash.

HARRI KARI or **HARA KIRI** ("happy despatch"), a Chinese term for a method of self-destruction which is common in Japan, and is effected by the infliction of two gashes in the abdomen in the form of a cross. Military officers, governors, and all officials who have committed any serious offence may be invited by their superiors to perform this act and so die an honourable death, in preference to undergoing degradation and disgrace and depriving their families of their property. The act is sometimes performed voluntarily on the death of a leader by some of his followers who wish to display their devotion, and it is occasionally resorted to to escape the disgrace of an intolerable affront for which no redress can be obtained.

HAR'RIER or **HAR'IER** is the English name for the hound employed in hunting the hare. It is similar to the foxhound, from which it differs chiefly in its smaller size and its inability to run so fast. Its scent, however, is extremely keen, which enables it to follow all the doublings of the hare. Persons hunting with harriers are exempt from taking out a game license.

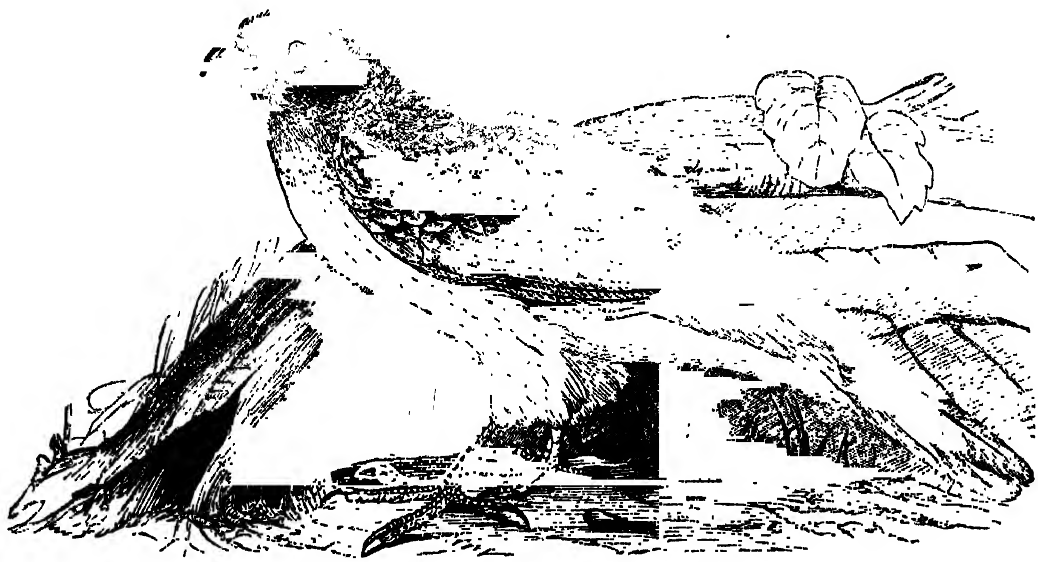
HAR'RIER (Circus) is a genus of birds of prey belonging to the family FALCONIDÆ. These birds are so called from their habit of *harrying* or destroying poultry, &c. The harriers have a certain superficial resemblance to owls, as indicated by the softness of the plumage and the greater size of the eyes and ears, accompanied, in some species, by a radiating arrangement of the feathers of the face, presenting a certain degree of resemblance to the well-known facial discs which give the owls such a curious staring aspect. These characters, however, do not indicate any real affinity between the harriers and the owls. The harriers are almost world-wide in their distribution.

The Common Harrier or Hen Harrier (*Circus cyaneus*) is generally distributed in Britain, although now, like most birds of prey, becoming far less common than it was but a few years back. It inhabits the temperate parts of Europe and Asia, but appears to become less abundant towards the north. The male of the common harrier measures about 18 inches in length, and is of a light bluish-gray colour on the upper surface, with the primaries of the wings nearly black; the lower surface is ashy gray, becoming paler on the belly. The female, which is about 2 inches longer than her partner, differs from him completely in colouring, being of a uniform brown colour above and reddish-buff beneath, while the lateral tail feathers are barred transversely with two shades of brown. From this latter character the female is sometimes called the ringtail, or ringtailed harrier, having been for long regarded as a distinct species. The wings in both sexes are about 2 inches shorter than the tail; the bill is black, the cere and feet are yellow, and the claws black. This bird is usually found in flat, marshy districts, on low moors and commons. Its flight is buoyant and easy, not unlike that of the buzzards. The food of these birds consists of snakes, frogs, poultry, young rabbits, &c. The nest of the harrier is usually placed upon the ground, and rudely built with a few small sticks and pieces of coarse grass.

In this primitive cradle the female deposits four or five eggs, which are of a white or very faint bluish colour.

The Marsh Harrier (*Circus æruginosus*), which is more commonly known as the Moor Buzzard, is another British species, rather larger than the preceding, the male usually measuring 21 and the female 23 inches in length. It is pretty generally distributed in this country, but by no means common in any locality; it occurs all over the continent of Europe, in the north of Africa, and in Asia as far as India. In its habits it agrees very closely with the common harrier, but it is said to prefer preying upon aquatic birds—whence probably its name of the Duck Hawk—and also occasionally to capture fish.

Montagu's Harrier (*Circus cineraceus*), a third British species, is a little smaller than the common harrier, from which it may also be easily distinguished by the great length of its wings, which reach quite to the extremity of the tail. The difference of colour in the two sexes is as great as in the common kind. This species has a more southerly range than the hen harrier. It is the commonest variety in the south of England. Other species of the genus Circus occur all over the world.



The Common Harrier (*Circus cyaneus*).

HAR'RINGTON, JAMES, an English political writer, was born in 1611. He is best known as the author of "Oceana," which was published in 1656. The book is a political romance, giving the author's idea of a republic framed so as to secure the greatest amount of freedom and happiness. Harrington was a pupil of Chillingworth's at Trinity College, Oxford, and was one of the parliamentary commissioners during the Civil War, although he had been a friend and follower of Charles I. till the death of that monarch in 1649. After the Restoration he was imprisoned for a time, and his last years were spent in retirement. He died in 1677. There is a magnificent portrait of his peculiarly interesting head at the National Portrait Gallery.

HAR'RISBURG, an important city of the United States, North America, capital of the county of Pennsylvania, on the Susquehanna, which is crossed here by four handsome bridges, one of which is a covered railway bridge, 2876 feet in length. It is situated 106 miles W.N.W. of Philadelphia, and has the usual public edifices of a large town. Great quantities of coal and ironstone are raised in the neighbourhood, and it has extensive manufactures of iron and cotton goods, and several tanneries, breweries, and potteries. There is also some trade in timber. The population in 1880 was 36,600.

HAR'RISON, JOHN, was born at Faulby, in Yorkshire, in 1693. Harrison early displayed an attachment to mechanical pursuits, and his attention was particularly directed to the improvement of clocks. After many failures and many minor improvements, he at length succeeded in constructing a pendulum, the excellence of which depended on the different degree in which metals are expanded or contracted by variations of temperature. In 1735 he came to London with a timepiece which he had constructed, to compete for the prizes offered by the government in 1714 in reference to the longitude. After several trials, he produced a chronometer which erred only 5·1 seconds in a voyage from England to Port Royal; this was sufficient to determine the longitude within 18 miles, and after twenty-two years of struggling and delay Harrison received the prize of £20,000 in 1767. Harrison introduced many and varied improvements in clocks, chronometers, and watches. He died 24th March, 1776, in his eighty-third year.

HAR'ROW. See AGRICULTURAL IMPLEMENTS.

HAR'ROWGATE or **HARROGATE,** in the county of York, is one of the most important inland watering-places in the north of England. It is 22 miles west from York and 199 miles from London, with a station on the North-eastern Railway. It consists of two principal sections, High and Low Harrowgate, and is situated at the head of a ridge of millstone grit, which slopes considerably on the east, west, and north. The general elevation is about 800 feet, the surrounding country is pleasant and covered with young plantations, and the climate is dry and bracing. Its spa has been famous since its discovery by Sir W. Slingsby, about 1596, but the prosperity of the town dates chiefly from the development of the railway system in 1840. There are now several handsome hotels, numerous excellent lodging-houses, large and well-fitted baths (the Victoria, Montpellier, Starbeck, and Harlow Car), a splendid promenade and pump-room (the Royal Cheltenham), reading-rooms, bazaars, and the usual *agrémens* of a fashionable watering-place. A spacious public market was erected in 1874. Public baths were built by the improvement commissioners in 1872 at a cost of £20,000.

There are several churches and chapels. St. John's Church was erected in 1856; and All Saints Church, at Harlow Hill, continental in character, was built in 1871. Harlow Tower, on Harlow Hill, is 100 feet high. From its summit may be seen Lincoln Cathedral and the Derbyshire Peak. The mineral springs are nearly all situated in Lower Harrowgate. They are of four classes—strong and mild sulphur waters, and pure and saline chalybeates. Of the former, which are so useful in bilious and digestive disorders, there are two wells, the Old and the Montpellier; while the mild are much more plentiful, and extend to places such as Starbeck, some distance off. The bog springs in Low Harrowgate are interesting, as rising (to the number of seventeen) all very close to each other, though many of them differ as to character. The Montpellier Gardens are a favourite place of resort, and very agreeably laid out. The population in 1881 was 9482.

HARROW-ON-THE-HILL is a village of Middlesex, 11 miles from London by the North-western Railway. Its situation is exceedingly picturesque, and of late years it has been much improved. Several good houses have been built for the masters and pupils of its celebrated grammar-school, which was founded by John Lyon, a wealthy yeoman of the parish, in 1571. The scholars are chiefly the sons of the nobility and gentry. Byron and Sir Robert Peel were educated here. A new school-chapel was erected in the High Street, opposite the school, in 1859; and in 1863 a handsome library was added to the school in memory of Dr. Vaughan, who was many years headmaster. The population of the parish in 1881 was 10,277.

HARRY, BLIND, as he was commonly called, or *Henry the Minstrel*, was a simple rustic, blind from birth, who lived towards the close of the fifteenth century. The work for which Blind Harry is celebrated is a poem on the adventures of Wallace, produced about the year 1461. He roamed through the country with this and other poems of his own composing, singing parts of them in the halls of the nobles, to the accompaniment of his harp, and subsisting on the gifts he received. Blind Harry is mentioned in records of the court of James IV., about 1490, as receiving gifts of 5*s.*, 9*s.*, and 18*s.* That such a man could compose an epic of 11,861 lines, not devoid of considerable poetical merit, is certainly astonishing. There are indications of derivation from original sources now lost, which may explain it.

HAR'TEBEEST (*Alcephalus caama*) is a species of antelope occupying the plains of the interior of South Africa in considerable herds. It is a large species, standing nearly 5 feet high at the shoulders, which are much elevated. The head is long and narrow. Horns are present in both sexes. They are of moderate length, approximating closely at the base and ringed through the lower half, diverging and again converging towards the tips. The general colour of the hair is grayish-brown. The back, the nose, and the hind and fore legs are marked with dark streaks; the chin is also black. The hartebeest is difficult of approach, easily taking alarm. Its manners are mild and tractable, but when brought to bay it makes good use of its powerful horns. The flesh, though inferior to that of the eland, is fine grained and much esteemed. The female produces a single calf at a birth, which if taken young is easily domesticated.

HART'FORD, the capital of Connecticut, United States, is situated on the right bank of the Connecticut, about 50 miles from its mouth and 100 miles north-east of New York. Its site is considerably elevated, and the surface somewhat broken. Many of the streets are broad and well built, and cross each other at right angles. The chief buildings are the old state-house, the new state-house, occupied since 1879, numerous churches of various denominations, Trinity College, in connection with the Protestant Episcopal Church, and an athenæum. The city also contains a large number of benevolent institutions, chief among them being the American Asylum for the Deaf and Dumb, the first institution of the kind in the United States. Hartford is advantageously situated for trade, manufactures, and commerce. It is in the great line of railways connecting the New England with the middle, southern, and western states; and Connecticut River, which is navigable to Hartford for sea vessels and steamboats of 1000 tons burden, admits the passage of small boats as far as Newbury in Vermont, a distance of 220 miles, but it is generally closed by ice from the middle of December to the middle of March. The most important articles of manufacture in the town are firearms and hardware of various kinds. Book publishing has also always been carried on to a great extent. The population in 1880 was 42,551.

HAR'THACNUT (sometimes called, by corruption *Hardicanute*) was the eldest son of Canute the Great, king of England, Denmark, and Norway, by Emma, daughter of Richard I., duke of Normandy. The death of Canute in 1035 brought forward as claimants to the inheritance Swegen and Harold, his two sons by his first wife Ælfgifu, daughter of Ælfhelm, earl of Deira; Harthacnut, his son by Emma; and Edward, the elder of the two sons of Emma by her former husband King Ethelred. A civil war was prevented by an agreement that the authority of Harthacnut should be confined to Denmark and that part of England to the south of the Thames, and that all the rest of England should be resigned to Harold, Swegen taking Norway. Meanwhile Harthacnut remained in Denmark, leaving the government of his English province in the hands of his mother Emma and Earl Godwine of Wessex till the invasion of England, in 1037, by his half-brother Alfred, his mother Emma's younger son by King Ethelred, when Emma fled to the Continent, and Harold put Alfred to death and became undisputed king of all England. On the death of Harold a deputation arrived from the English nobility offering the crown to Harthacnut, who came over and assumed the government. He was at Bruges when the messengers arrived, having joined the lady Emma his mother there. His first act was to dig up the body of his paternal half-brother, the late King Harold, and insult it; his second to invite his maternal half-brother, Edward the Atheling, from Normandy, and to acknowledge him for his successor. He levied a heavy Danegeld to support the Danish navy, which he jealously kept near him, and kept a standing army of *housecarls*, like his father Canute, the first royal soldiers in England. Harthacnut seems to have been a rather brutal debauchee. He died suddenly 8th June, 1042, at a drinking bout at some wedding festivities, and Edward the Confessor, his half-brother, reigned in his stead.

HAR'TLEPOOL, a parliamentary borough and seaport of England, in the county of Durham, situated on a peninsula 12 miles north of the mouth of the Tees, 20 south-east from Durham, and 264 from London by the Great Northern Railway. St. Hilda founded a monastery here, and King John granted a charter to the town in 1200. So early as 1052 Hartlepool was ordered to provide a ship of war. In 1269 it was held to be in the county of Northumberland, while Parliament declared it to be in the county of York; in 1535 and in 1614 it was decided as within the bishopric of Durham. A parliamentary commission sitting in 1620 recommended that Hartlepool should have a member of Parliament, but in 1831 the population was only 1250. Docks were opened in 1835, a local company having been formed to extend the trade of the port, and in 1848 they were leased to the North-eastern Railway Company. In 1850 a reformed charter was granted to the town. The trade has since much increased, and with it there has been a considerable extension in the shipping accommodation and buildings. The streets and sanitary arrangements have been much improved

by the local board of health, and there is an excellent supply of water. The harbour is safe and easily accessible. The shipping trade consists chiefly in the export of coals and the import of timber. The docks have recently been enlarged, and can now accommodate 500 vessels. Iron shipbuilding is carried on extensively, and there are also iron and brass foundries, sawing and planing mills, chain and cable works, rolling mills, and glass and cement works. The place formerly depended to a great extent on its fisheries, and they are still of some local importance. There are several churches and dissenting chapels, a borough hall, with a covered market behind, mechanics' institute, athenæum, exchange, freemasons' hall, and a commodious theatre. There is a pier, and the headland north of the town is protected by extensive works from the action of the sea. Some batteries have been erected by the government for the protection of the harbour, and there are some barracks for the militia. The cliffs at the north of the town are bold and abrupt, and their summits command a magnificent view of the sea and the coasts of Durham and Yorkshire.

HARTLEPOOL, WEST, a modern market-town and seaport, connected with the ancient borough of Hartlepool by a narrow neck of land known as Middleton, and practically forming one town with Hartlepool, which it now exceeds in commercial importance. West Hartlepool is quite of modern growth, having been founded by Mr. R. W. Jackson in 1847. There are several churches, including a large and handsome Gothic church, and an ancient church at Stranton, several dissenting places of worship, large hotels, athenæum, mechanics' institute, spacious covered market, an exchange, erected in 1875, custom-house, Freemasons' and Druids' halls, and theatre, besides other public buildings. Iron shipbuilding is carried on to a large extent, the government frequently placing contracts with local shipbuilders, and there are extensive iron foundries, blasting furnaces, rolling mills, cement works, &c. The harbour, 12 acres in extent, and first constructed in 1847, has since been very considerably enlarged. There are merchandise and coal docks, covering an area of 170 acres, besides a timber dock and ponds of 100 acres water area, timber yards of 80 acres, and several graving docks. The warehouse-room is very extensive. The port was intended chiefly for colliers, but a large foreign trade has sprung up, and the imports now include flax, hemp, grain, timber, butter, cheese, fruit, cattle, sugar, cotton and woollen manufactures, zinc, tallow, yeast, iron, and all kinds of American goods, &c.; the exports are coal and coke, cotton, hides, hardware, oil, drugs, painter's colours, earthenware, cement, soda, alkali, worsted stuffs, yarn, oakum, emery powder, naphtha, machinery, seeds, salt, veneers, yellow metal, felt hats, paper, wool, bricks, &c. The number of vessels registered as belonging to the ports of Hartlepool and West Hartlepool in 1884 was 258 (202,152 tons). The entries and clearances average 3600 (900,000 tons) per annum. The Royal Commission for Harbours of Refuge, which sat in 1858, recommended Hartlepool Bay as one of the best places on the north-east coast for a refuge harbour. West Hartlepool was, in conjunction with the old town of Hartlepool and some adjoining townships, constituted a parliamentary borough by the Reform Bill of 1867, and now returns one member to the House of Commons. The number of voters in 1884 was 7460. Th population of the parliamentary borough in 1881 was 46,990.

HART'LEY, DAVID, an eminent English metaphysical writer, was born on the 30th of August, 1705 and was the son of a clergyman of Armley, in Yorkshire. Having been first educated at a private school, he entered at fifteen years of age, at Jesus College, Cambridge, an became in time a fellow of that society. Scruples which would not allow him to subscribe the Thirty-nine Articles prevented him from afterwards entering the church, as had been originally intended; and he applied himself to the medical profession, in which he attained to considerable eminence.

He commenced the composition of the work by means f which he has become universally known—"Observations n Man, his Frame, his Duty, and his Expectations"—at he age of twenty-five. The fundamental idea of the work, he possibility of explaining all states of mind by associaion, was first suggested to him by Mr. Gay's "Essay on he Fundamental Principle of Virtue or Morality," prefixed o Law's translation of Archbishop King's "Origin of Evil." His work was published in 1748. He lived nine ears after the publication.

Dr. Hartley was twice married, and had children by oth marriages. He practised medicine successively at Newark, Bury St. Edmund's, in London, and at Bath, where he died on the 25th of August, 1757. He enjoyed hrough life the friendship of many distinguished literary nen. Among these may be mentioned Bishops Law, Butler, Warburton, and Hoadley, Dr. Jortin, Young the poet, and Hooke, the author of the "History of Rome."

HART'S-TONGUE FERN (*Scolopendrium vulgare*) is a particularly handsome and ornamental fern, and very different from every other British species. It is universally and abundantly distributed throughout the British Isles. t is very commonly found on old walls and ruins. It is also found in Europe, sparingly towards the north, and in he United States. This fern is the Phyllitis of Ray and ll older botanists. It was once much used as a medicine. Ray mentions it as an astringent, and speaks of its healing powers applied as an ointment to wounds and ulcers. The genus belongs to the tribe Aspleniеæ. See FERNS.

HARUS'PICES or **ARUS'PICES,** a class of priests n ancient Rome whose principal duty was to inspect the entrails of victims, and thereby foretell future events. They also interpreted unusual natural phenomena, such as lightning and earthquakes. The haruspices derived their art from Etruria, and were always held to be charlatans by the Romans of the educated classes. Cicero, himself an augur, relates a saying of Cato that he wondered one haruspex could look another in the face without laughing. The haruspices must be distinguished from the legitimate Roman state-augurs, who observed the flight of birds, &c., and thus ascertained the will of the gods on any great political occasion; the latter had large official powers, the former were simple soothsayers. See AUGUR.

HAR'VARD COLLEGE, in Cambridge, Middlesex county, Massachusetts, United States, was founded in 1638, and so named in honour of the Rev. John Harvard, who gave it £700. The present value of the buildings, grounds, and endowments belonging to the college, including the library and apparatus and the invested funds, is about 4,000,000 dollars. The government is vested in the president, five fellows, and a board of overseers appointed by the state legislature. The Unitarians have at present a numerical majority on the board of council, and may be said to control the institution, but do not exert any conscious denominational influence. There are altogether over 100 tutors, including professors of law, medicine, science, and divinity; 1200 students; 240,000 volumes in the library; while the annual current expenses amount to over 180,000 dollars. The college, or university, as it is sometimes termed, is a very flourishing one, and many of the most distinguished Americans have received their education in it.

HARVEST. In southern countries, where the heat and want of moisture are not too great for the growth of corn, the only care of the farmer, as to harvest, is to procure hands sufficient to reap it. The heat of the sun and air soon dry the straw and harden the grain. A spot is levelled in the field, and the corn is thrashed out

immediately, either by the tread of cattle driven over it or by the flails of numerous thrashers. The corn is winnowed and stored in granaries: the straw is reserved till winter, when it forms the chief fodder of horses and cattle. But in northern climates, where the harvest is later, and cold rains and storms are frequent in autumn, ingenuity was formerly often taxed to save the corn, after it had been cut, from being entirely spoiled. The reaping machines, however, now in pretty general use, have, in England at least, vastly accelerated the process of cutting, and so diminished the risk from exposure of the crops to bad weather.

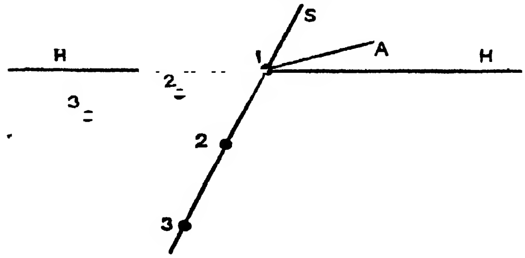
It was long the custom throughout the whole of the north of Europe to store all the produce of the farm into barns, but the increase of the produce raised by an improved system of agriculture gave rise to the practice of stacking corn in the open air, and securing it by a covering of thatch. Formerly corn was so cut as to leave much of the straw standing on the ground, but modern farming is so conducted that the straw is cut as near the ground as possible.

When the stack is building, the butts of the sheaves are placed outwards, and project gradually over the sides of the frame, and over one another, so as to build the stack in the form of a bowl, with a cone or pyramid over it, according as the frame is round or square; this is carefully thatched with straw, and the outer surface is cut smooth by means of shears. Various other forms of stack-building are adopted in different countries. Harvest is proverbially a joyous time, and one when hospitality is practised with more goodwill than at any other season save Christmas. Harvest-home rejoicings, when the last corn is carried, have been observed in England from time immemorial. It is now also increasingly customary to hold harvest services of thanksgiving in places of worship, when the corn and fruits of autumn are grouped round the building to form a lively natural decoration, and excite the mind to thankfulness for the bounties of the earth.

HARVEST BUG is the popular name of a member of the order ACARIDEA or Mites, formerly described under the name *Leptus autumnalis*. Recent investigations have shown that the harvest bug is only the six-legged larva of the Scarlet Mite (*Trombidium holosericeum*). The harvest bug is very minute, but its brilliant crimson colour and the irritation which its presence causes, saves it from insignificance. It is especially abundant in corn-fields at harvest time. It attaches itself to the legs of human beings and burrows beneath the skin, causing considerable irritation. Rubbing the part affected with some essential oil is the best remedy. This little pest also attacks dogs, cats, and other animals.

HARVEST-MEN or **HARVEST SPIDERS** are common names for the members of the order Phalangidea belonging to the class Arachnida. The harvest-men have short thick bodies and extremely long and slender legs. The abdomen is segmented and not distinctly separated from the cephalothorax. The maxillary palps are thread-like and furnished with a single claw. Respiration is by tracheæ. There are no poison-glands nor spinning organs, and the female is provided with a long ovipositor. The harvest spiders are world-wide in their distribution, the species being tolerably numerous. They live under stones and among leaves, moss, and rubbish. They are extremely voracious, and supported on their stilt-like limbs run with great rapidity among plants in our gardens and fields in search of insect prey. Sixteen British species have been described: the best known (*Phalangium opilio*) is about a quarter of an inch in length, of an ashy-gray colour.

HARVEST MOON. About the time of harvest the full moon is observed to rise night after night immediately upon the sunset, instead of rising later by about fifty minutes a night according to the usual average. This in the eyes of simple rustics is so manifest a provision for helping with the harvest that it is called the "harvest moon." The phenomenon is singular, but easily explicable. Near the autumnal equinox the earth is so placed that in our country the ecliptic (which may be roughly regarded as the moon's path) makes with that half of it visible at sunset the least possible angle with the horizon. If it made no angle whatever—that is to say, if the horizon were parallel with the ecliptic—the moon would of course rise actually at the same time night after night, which is the case with the harvest moon in lat. 64° 27′. This is not the case with ourselves; but as the angle is only 15 degrees, the retardation, instead of being about fifty minutes, is less than twelve. The opposite effect happens in England at the vernal equinox, when the moon's path is very steeply inclined to the horizon (about 61 degrees), and here the retardation on successive nights amounts to as much as an hour and eight minutes. A diagram will make this clearer. Let H H be the horizon, A the moon's path in autumn, S in spring. As the effect of the moon's rising is produced by the earth's rotation, or in other words by the horizon descending upon the moon, it is manifest that the horizon will arrive at the successive nightly positions, 1 2 3 A, of the moon in autumn with little increased delay, whereas the nightly



difference between her positions, 1 2 3 S, in spring will be considerable. The moon moves 13 degrees in her orbit every twenty-four hours, and the distance between the positions 1 2 3 in the diagram is meant to represent this nightly difference. The earth, therefore, in turning on her axis, has to turn a little more than a revolution from one night to the next to bring the moon on the horizon again at the following moonrise.

Of course a full moon does not necessarily coincide with the autumnal equinox, but the harvest moon is held to be that which occurs next before the equinox. When the equinox comes just at new moon, the two full moons a fortnight on each side of it will almost exactly resemble each other in their harvest-moon qualities, and the first is then called the *harvest moon*, the second the *hunter's moon*. In the case of full moon occurring only a week after the equinox it is perhaps more usual, though probably less correct, to call it the harvest moon instead of the hunter's moon. It is of course the full moon which comes nearest to the equinox which exhibits most strongly the peculiarity above described, whether it occurs before the equinox or after it.

HARVEST MOUSE (*Mus minutus*) is a beautiful little creature, one of the smallest of British quadrupeds, and appears to have been first noticed by White of Selborne. Besides grain it feeds upon flies and other insects, worms, &c., and when full-grown weighs about the sixth part of an ounce. It measures about 2½ inches in its body, and its tail is nearly of the same length. This little mouse is reddish-brown above, pure white beneath. The harvest mice abound in corn-fields during the summer. Many of them are carried into ricks and barns with the sheaves of corn, and thus are comfortably housed for the winter in the midst of a bountiful supply of food. Others, less fortunate, have to burrow into the ground to escape the

rigours of winter; this season they pass in a state of partial hibernation. The harvest mouse constructs an exceedingly beautiful little nest, which is suspended, often several feet from the ground, among rushes, the stalks of corn, or in the head of a thistle. This little nest is about the size of a cricket-ball, and nearly as round; it is composed of blades of wheat or grass-leaves woven together so as to leave no visible outlet. A nest found by Gilbert White was "so compact and well-filled that it would roll across the table without being discomposed, though it contained eight little mice, naked and blind." Several litters are produced in a year, from five to nine being produced at a birth. The harvest mouse rivals a New World monkey in its agility; its prehensile tail materially aids the little animal in climbing stalks of corn and grass. The harvest mouse occurs in Great Britain as far north as Aberdeenshire, but is most abundant in the southern English counties. It is very rare in Ireland. It extends over Europe to Siberia.

HARVEY, SIR GEORGE, a celebrated Scottish painter, a native of the village of St. Ninians, near Stirling, was born in February, 1806. His father, who was a watchmaker, removed to Stirling shortly after Harvey's birth. At an early age he was apprenticed to a bookseller, but his love of art was even then so absorbing that every spare moment was devoted to the use of the pencil and the brush, and in the summer mornings he went out into the fields with his sketch-book as early as four or five o'clock, engaged in delineating the picturesque scenery of his native district. In his eighteenth year the desire of his heart, to enter on a regular course of artistic training, was gratified by his being enabled to study at the Trustees' Academy in Edinburgh. He remained there about two years, making very rapid progress, and producing even at that early period works of remarkable merit and promise. The unpopular manner in which the Edinburgh Royal Institution for the Encouragement of the Arts was managed by its governing body provoked the Scottish artists to establish, in 1826, an academy of their own, framed on the model of the Royal Academy of London; and Harvey, though only twenty years of age, was solicited to join the new confederacy; indeed it was to him and his two friends, Mr. W. Nicholson, the first secretary, and Mr. Thomas Hamilton, that the infant institution owed much of its stability and youthful vigour. Of his two associates in the enterprise Harvey said that they "were the real founders and promoters of the Academy, but for whom the vessel would have been upon the rocks before it had well got under weigh." The youthful painter devoted himself, with characteristic energy and zeal, to the promotion of the interests of the new Academy, and fought valiantly on its behalf against the champions of the rival establishment which had pre-occupied the field, until the contest was happily ended by an amicable treaty of amalgamation. Harvey took care, however, not to allow this "wordy war" to divert his mind from the diligent pursuit of his profession, and the pictures which in rapid succession issued from his studio speedily obtained a high position among the finest productions of Scottish artists. When the Academy opened its doors for the first time, he enriched the exhibition with no less than seven pictures. His career from this time forward, through a long series of years, was that of a most industrious artist, exhibiting constantly at the national exhibition pictures which took the national taste and were made widely known by means of excellent engravings. In 1829 Harvey, who was one of the original associates of the Scottish Academy, was promoted to its full honours. In 1830 appeared the "Covenanter's Preaching," the first of the series that won for this painter conspicuous honour and popularity, and on which his permanent reputation will rest. The "Covenanter's Baptism" was exhibited in 1831, the "Battle of Drumclog" in 1836, and the "Covenanter's Communion" in 1840. The two first-named and the last are masterpieces, alike yet different, the scenery the same in its general features, but the characters varied and nicely adapted to the different incidents and actions portrayed. In all three pictures the scene of the sacred services is a wild upland glen, common among the mountain ranges of Scotland, shut out by the surrounding hills from the view of the neighbouring country —truly a "barren scene and wild," in keeping with the fortunes of the faithful remnant who have been driven into the wilderness to "keep their Sabbath" and to enjoy its sacred privileges. The Covenanters, male and female, have the national stamp on their thoughtful, intelligent, earnest features; from the venerable patriarch of threescore and ten in the "Preaching," leaning on his staff—in the "Communion" the minister, the type of a Cameron or a Cargill; the three grave, strong-featured men, well stricken in years, who are officiating as elders; the two stern-looking men among the small band of communicants, with their arms ready to resist tyranny to the death; the young girl, simple, modest, devout, who might have sat for the portrait of Margaret Wilson, one of the Wigtown martyrs, down to the boy beside his faithful collie, and the urchins dropping pebble after pebble into the pool and watching its widening circles in the "Baptism"—all is Scottish to the backbone.

There are other paintings from Harvey's pencil which display a similar spirit—such as his "Earl of Argyll an Hour before his Execution" (1842); his "First Reading of the Bible in Old St. Paul's" (1847), a grave and elaborate picture, which greatly added to his reputation in England; "Sabbath Evening" (1841); "The Minister's Visit" (1843), containing a likeness of the Rev. Dr. Brown of Broughton Place Church, Edinburgh; "The Past and the Present;" "Children Blowing Bubbles in Old Greyfriars' Churchyard" (1848)—a sermon on canvas—full of sweet and solemn meaning; "John Bunyan in Bedford Jail," selling laces from his prison window (1838), full of manly pathos; "Highland Funeral" (1844), a burial among the hills, which, though very simple—little more indeed than a sketch of moorland with clouds brooding over it—is singularly impressive; so are "Glen Enterkin" (1846); the "Head of the Glen" (1854); "Sabbath in the Glen" (1858), and other truthful, earnest, and sympathetic delineations of stern Highland solitudes. Not less interesting and impressive, though quite in a different style, is Harvey's "Quitting the Manse" (1848), a scene connected with the disruption of the Scottish Established Church, containing portraits of the Rev. Dr. John Bruce, Earl Dalhousie, Alexander Murray Dunlop, M.P., and other leading Free Churchmen.

But though Harvey's most celebrated pictures are illustrative of incidents in the stormy history of the seventeenth century, and partake of its sombre and suffering character, he was by no means limited to one class of subjects. He possessed a rich vein of that national humour, the existence of which witlings who live within the sound of Bow Bells have thought fit to deny; but as it is a prominent feature of the Scottish character, it occupies a conspicuous place both in the literature and the art of the country. The earliest and one of the most successful of Harvey's pictures of this class is "The Examination of a Village School," painted in 1832. The pompous solemnity of the dominie, the demure aspect of the boys repeating their lessons, the byplay on the back forms, the poor dunce striving in vain to impress the task on his dull brain, the selfish little glutton devouring his store of sweatmeats and turning a deaf ear to the offer of his playfellow to barter a peg-top for a share of his tempting stores—all are true to the very life. The kindred picture, "The Dismissal of the Village School," is an equally beautiful and interesting sketch of homely life, full of the same quiet humour. The "Curlers," painted in 1835, is perhaps the most successful,

as it is the best known, of all Harvey's delineations of Scottish life, exhibiting not a little of the style of Wilkie's pictures, yet thoroughly original as well as ingenious in its treatment of Scotland's national game.

Some ardent admirers of Harvey's paintings, however, are of opinion that it was perhaps after all in landscape that he was at his greatest and best. The infinite loveliness and subtle charm of the pastoral scenery of Scotland's southern mountains have had no such interpreter, and even his Highland scenes have the marked impression of the painter's own sober, grave, and gentle nature. His pictures were transcripts of his own thoughts, and his whole nature and nothing else ever was expressed in them. Take him all in all, as a painter of incident and character, and of what may be called meditative landscape, Harvey must rank among the highest of British artists. Truth to nature, strength, freshness, and tenderness of thought and feeling, vivid perception of character, especially in children, honesty of purpose and of means in his art, and a general flavour of strong sense and simplicity, mark all his works. In his own line he is undoubtedly our chief historical Scottish painter. His paintings have, through the medium of engravings, become household works in hall and hamlet, as illustrative of the piety, the patriotism, the sturdy virtues, and the keen affections of the Scottish people. They appeal irresistibly to the Scottish heart. One of the most accomplished writers of the day, who knew him intimately, says Harvey was a delightful companion, one of the truest and warmest of friends, generous in thought and deed, full of truth and courage, and through his whole life a man of independent mind. Yet he was also endowed with that childlike softness of nature which responds at once, and with the whole soul, to the test of pathos and of humour. His cordial beaming face, his snowy hair, his welcoming smile, his ever ready sympathy in suffering and in happiness, will long be cherished.

In 1864, on the death of Sir John Watson Gordon, Harvey was elected by his brother artists to the distinguished position of president of the Royal Scottish Academy. The honour of knighthood, which the crown had latterly thought proper to bestow upon the occupant of the president's chair, followed in due course—a well-merited tribute to his artistic excellence and high character. He discharged the duties of his office with marked assiduity and courtesy, and full of years and honours he passed away on the 22nd of January, 1876, at the age of threescore and ten.

HARVEY, WILLIAM, to whom is usually attributed (though to a great extent inaccurately) the discovery of the circulation of the blood, was born at Folkestone, in Kent, 1st April, 1578, and after having been some years at the grammar-school of Canterbury, was admitted at Caius College, Cambridge, in the year 1593, being then in his sixteenth year. Having devoted himself to the study of logic and natural philosophy for six years in that university, he removed to Padua, at that time a celebrated school of medicine, where he attended the lectures of Fabricius of Aquapendente on anatomy, of Minadous on pharmacy, and of Casserius on surgery. He was admitted doctor of medicine there, and returned home at the age of twenty-four. At thirty he was elected fellow of the College of Physicians, and shortly after appointed physician to St. Bartholomew's Hospital. On the 4th of August, 1615, he was chosen by the college to deliver the Lumleian lectures on anatomy and surgery, and upon this occasion he is supposed to have first brought forward his views upon the circulation of the blood, which he afterwards more fully established, and published in his celebrated treatise entitled "Exercitatio Anatomica de Motu Cordis et Sanguinis," in 1628.

The discovery of the circulation is the work of seventeen centuries, and even Harvey did not fully demonstrate it, nor was the whole cycle known till nearly half a century after the publication of his famous treatise. The history of the discovery is best told by M. Flourens, in a most interesting little book, "Histoire de la Découverte de la Circulation du Sang" (Paris, 1854).

Before the time of the Greek Galen opinions on the circulation were curiously wrong. The blood was supposed to be distributed to the various parts of the body by means of the veins, and that intended for the nutrition of the lungs by the action of the right side of the heart. According to the same doctrines the arteries were destined for the conveyance of the vital spirits, which were formed in the left side of the heart from the air and blood derived from the lungs. These vital spirits were supposed to be taken in by the arteries during their diastole, and distributed by them during their systole, while the vapours or fuligines were returned to the lungs by the action of the left ventricle. The mode in which the blood found its way to the left side of the heart was through certain imaginary pores in the septum between the ventricles. First Galen, in the second century of our era, by simply opening an artery in the living subject, showed that blood issued and not air. The error had arisen from the dissection of dead bodies only, when the ancients always found the arteries empty and the veins full of blood, as we now see was necessarily the case. The opinion was that the air conveyed by the arteries *cooled* the blood. Galen believed in the holes between the sides of the heart; and although we know most positively that there are none and never could have been any, plentiful accounts exist of these imaginary holes having been actually seen! Galen considered the *spirituous* (arterial) blood of the arteries went to the finer organs, lungs, &c., and the dark venous blood to the coarser organs, as the liver. As time went on anatomists grew uneasy about these holes in the heart for the mingling of the two kinds of blood. De Carpi complains that *cum maximâ difficultate videntur*, and finally Vesalius was outspoken enough in 1543 to say that there were no holes at all, and his great authority settled the point. The third error remained, that the veins carried blood *to* the tissues. This fell before Michael Servetus (whom Calvin burned at the stake for his advanced theological opinions) in 1553. In his "Christianismi Restitutio" the pulmonary circulation is firmly and clearly stated thus—"This communication [of the two sorts of blood] is not made by holes in the middle wall of the heart, as has been commonly believed. But the blood flows from the right ventricle into the lungs, and is there agitated, prepared, changes its colour, and is poured from the pulmonary artery into the pulmonary vein." In 1559 Realdo Colombo, and a little later Cæsalpinus, made the same discovery independently of each other, and not knowing of Servetus' previous discovery, buried as it was amid the theological speculations of a burnt heretic. Cæsalpinus was the first to use the phrase "circulation of the blood," and to hazard the guess that the blood in the veins set towards the heart, "because," he says, "when you apply a ligature the veins swell beyond it, and not on the side nearest the heart, which latter ought to be the case if the blood flowed *from* the great organs (*a visceribus*) *to* the body, as generally believed" ("Quæstionum Medicarum"). It will be seen that Cæsalpinus stood upon the verge of demonstration, but did not actually make it. He was a great botanist, and his attention was drawn away elsewhere, or surely he could not have failed to complete the discovery In 1574 Harvey's master discovered the valves in the lungs, which surely, one would think, from pointing towards the heart, would show that they were to facilitate a flow towards the heart and to prevent the asserted backward current. Still, astonishing as it may seem, no one perceived this simple fact.

What, then, is Harvey's merit? Harvey actually demonstrated what others had only suspected. Their opinions, it is evident, rested more upon deduction than any careful

observation of facts. Those of Harvey, on the contrary, were drawn from the most accurate dissections of dead and living animals, and supported by arguments depending entirely upon the anatomical structure and obvious uses of the parts. The result of these observations is thus stated by him. The heart has periods of action and of rest, but in warm-blooded animals its motions are so rapid that the different steps of them cannot be distinguished. In cold-blooded animals the heart beats more slowly, and even in warm-blooded animals the rapidity of its movement is lost to a very great extent after the examination of its action, by opening the chest of a living animal, has been continued some time. During its action the heart is raised, and its point tilted forward so as to strike against the walls of the chest. It contracts in every direction, but more especially on its sides; it also becomes harder, as other muscles do during their contraction. In fishes and cold-blooded animals the heart may be observed to become paler during its systole, and assume a darker colour during its diastole. If a wound be made in the ventricle, the blood is ejected from it during its contraction. From these facts Harvey concluded that the essential action of the heart is its systole, and not its diastole, as was supposed by physicians before his time, and that the result of this contraction is the expulsion of the blood into the pulmonary artery and aorta. The diastole of the arteries or pulse is synchronous with and caused by the propulsion of the blood during the systole of the ventricle, and is a passive, and not, as was previously supposed, an active operation of the vessels. If the motions of the heart be carefully observed for some minutes, it will be seen, first, that the two auricles contract simultaneously, and force the blood contained in them into the ventricles; and secondly, that the ventricles in their turn assume the same action, and propel most of the blood into the pulmonary artery and aorta, from which it is prevented from returning by the valves situated at the entrance of those vessels. He then described the manner in which the blood passes from the right to the left side of the heart, and showed how it first passes through the lungs, then to the left auricle, and thence to the left ventricle. In like manner he showed that the blood is propelled from the left ventricle into the arteries, and so distributed to all parts of the body. He next proceeded to give approximate calculations of the quantity of blood which passes from the veins through the heart in a given time. This he showed to be so much more than is required for the nutrition, or can be supplied to the veins by the absorption of alimentary substances, that the surplus must of necessity somehow return to the veins again. He then argued from the construction of the valves of the veins that the course of the blood in them must be from the smaller to the larger divisions, and thus to the heart again.

Such is a brief abstract of Harvey's share in the greatest discovery in physiology, which was so directly opposed to all the current notions of physicians that its author feared injury to himself from the envy of some, or that he should make enemies of all. According to Aubrey these anticipations were to some extent realized, and that after the publication of his book "he fell mightily in his practice, 'twas believed by the vulgar that he was crackbrained, and all the physicians were against him." There does not, however, appear to be much truth in this story, for although it was a theory which, in the words of its discoverer, "was contrary to the received doctrine taught so many ages by innumerable learned and illustrious men," and opposed in many quarters, Harvey was able to acquire a fortune by his practice, and was held in honour by the members of his profession.

But we have asserted that Harvey's demonstration was incomplete. He failed, first, in not seeing nor suspecting the capillaries, and he never therefore showed how the blood got into the veins. He thought a good deal of it was left behind, to become tissue, and only the remainder carried on. Of the capillary force as a great factor in the circulation he had of course no idea whatever. Harvey saw the gap, and frankly admitted it; he said he thought the blood must pass from arteries to veins direct by anastomosis, but he could not detect the passage. Four years after Harvey's death, that is, in 1661, Malpighi, with the newly invented microscope, first discovered the capillaries; and in 1668 the microscopist Leeuwenhoek at last actually saw the blood in the capillaries, and traced its complete course through them from the arteries to the veins, in the tail of a tadpole. "Hereby," says he, in memorable words, which for the first time completely clear up this great mystery, "it appeared plainly to me that the bloodvessels I now saw in this animal, and which bear the names of arteries and veins, are in fact *one and the same*—arteries so long as they convey the blood to the extremities, veins when they bring it back towards the heart." Finally, Bichat showed that although the blood thus circulates in a long course of closed vessels, the capillary walls are so delicate as to allow, by endosmosis, sufficient percolation through them to nourish the tissues of the body.

Harvey subsequently published a book entitled "Exercitationes de Generatione" in 1651, which contains a description of the organs of generation in the common fowl, of the formation of the egg and its extrusion from the body, and of the use and nature of its various parts, as well as the changes which it undergoes during the process of incubation. In the same treatise are also some valuable observations on the process of generation in mammalia, which were confined chiefly to the deer species, of which he was enabled to obtain numerous specimens by the liberality of Charles I., who allowed him to take them from the royal parks.

In 1623 Harvey was appointed physician-extraordinary to James I., with a promise of succeeding on the first vacancy to the physicianship-in-ordinary, the duties of which he actually performed. He was afterwards physician to Charles I., and was in the habit of exhibiting to him and to the most enlightened persons of his court the motion of the heart and the other phenomena upon which his doctrines were founded. During the Civil War he travelled with the king, and while staying for a short time in Oxford was made by him master of Merton College, and received the degree of doctor of medicine. He held the mastership, however, for only a few months, when Brent, who had been expelled by the king for favouring the parliamentary cause, was replaced by that party, which had now gained the ascendency. Soon after his house was plundered and burned by the same party, and unfortunately several unpublished works, of which we have only notices in his other writings, were destroyed. The latter years of his life were chiefly spent at his country-house at Lambeth, or at his brother's near Richmond. In 1654 he was elected president of the Royal College of Physicians, but in consequence of his age and infirmities he was induced to decline that honourable office. He testified his regard for the society by presenting them with his library, and conveying over to them, during his lifetime, a farm which had been left him by his father. He died on the 3rd of June, 1657, in the eightieth year of his age, and was buried at Hempstead in Essex, in a vault which had been built by his brother. His remains, after reposing there for 226 years, were transferred, 18th October, 1883, to the Harvey Chapel of the Royal College of Physicians, and placed in a splendid marble sarcophagus provided by that body. The best edition of his works, which were written in correct and elegant Latin, is that published by the Royal College of Physicians in one vol. 4to, in 1766, with an engraving by Hall from the portrait by Cornelius Jansen, in the college library. A life of Harvey by Dr. R. Willis, and a translation of his works, were published by the Sydenham Society in 1847. A much enlarged biography was published by Dr. Willis in 1878. A bronze statue of Harvey was

erected at Folkestone, not far from the site of his birthplace, in 1881.

HARWICH (pronounced *Har'ridge*), a municipal borough and port of England, in Essex, at the mouths of the Stour and Orwell. It is 70 miles from London by the Great Eastern Railway. The area is 3306 acres, and the population in 1881 was 7842. It formerly returned one member to Parliament, but by the Reform Bill of 1885 it was merged in the county.

The town has been much improved in recent years, but some of the streets are exceedingly narrow. The chief buildings are the parish church of St. Nicholas, which is a very fine edifice. There are chapels for all denominations of dissenters and also for Roman Catholics. The town contains a town-hall, custom-house, &c., and the Great Eastern Railway Company has a handsome hotel overlooking the sea. A fine esplanade extends southward from the town, from which good views of the harbour and the German Ocean may be obtained.

The harbour of Harwich is one of the best, if not actually the best, on the east coast of England. It is largely used as a harbour of refuge, as it is the only place between Yarmouth Roads and the Thames capable of affording shelter to vessels during easterly gales. The fortifications have been very much enlarged and strengthened in recent years, and the harbour improved in various ways. Formerly Harwich was the ordinary port of departure from England to the Netherlands; but after the French War its trade rapidly declined, and it was for many years visited principally for sea-bathing. Its commerce has now partly revived, in consequence of the Great Eastern Railway Company having established a line of steamers from Harwich to Rotterdam and Antwerp in connection with their railway, thus materially reducing the time required for a journey from London to Holland. Grain, timber, and tobacco are imported, and cement is exported. Fishing and a little shipbuilding are carried on. The number of vessels registered as belonging to Harwich in 1885 was 150 (16,000 tons). The entries and clearances average 1700 (450,000 tons) per annum.

The trade has so much increased of late years that it has led to what will ultimately become a new town, for in 1883 the railway company erected on the estuary of the Stour, three-quarters of a mile from Harwich, a splendid new quay, where its vessels now disembark passengers and unload goods. This new port is called Parkeston. The quay is 1800 feet in length, and is provided with warehouses 1400 feet long and 60 feet broad. Adjoining it is a new railway station and hotel, with extensive waiting-rooms for the convenience of passengers. By means of certain extension lines the port has been brought into direct communication with Birmingham, Manchester, Sheffield, Leeds, and other great manufacturing centres of the kingdom. There are important shrimp and lobster fisheries near Harwich, and the town also contains cement works, breweries, and manufactories for artificial manure, sails, and tackle.

Within about a mile from Harwich is the suburb of Dovercourt, which is resorted to in summer for sea-bathing, the sands being admirably adapted for that purpose. It contains a very fine esplanade, many good houses, and the usual facilities for the accommodation and enjoyment of visitors.

Harwich is said to have risen into note and importance through the ruin of Orwell by the action of the sea. The traces of this drowned city are said to be still visible at low water 5 miles from the shore, at a spot now indicated by the West Rocks. The place was probably used as a stronghold in the British times, and afterwards as a station by the Romans. It afterwards became a Saxon village, but the earliest authentic historical incident connected with it was the battle at the mouths of the Orwell and the Stour between King Alfred's fleet and sixteen Danish ships in 884.

HARZ MOUNTAINS, a mountain group of North Germany, which rises with extraordinary suddenness from the great plain in terraces and steep slopes, and forms a series of short ridges cut off from one another by winding glens and valleys, the prevailing direction being nearly north and south. Their elevation is dependent on an upheaval of granite, which forms the nucleus of the group, and rises in spiry pinnacles in many places; in others, as in the Brocken, it forms long high ridges, declining not very steeply with a nearly equal north and south slope. The granite has brought up with it the old slates and silurian rocks, and these are interpenetrated greatly by veins of granite and other igneous rocks. Red sandstones (old red and bunter) cover these on the lower slopes, and the newer secondary rocks on the north and east come close in upon the base of the mountains. The north and west part of Ober-Harz is the smallest, having an area of 287 square miles, and it also has the greatest general elevation, about 2100 feet, the most rugged hills, and the deepest glens. The glens and valleys are narrow, with precipitous or steeply sloping sides. The scenery of the Unter-Harz, or south part, which has an area of 502 square miles and general elevation of 1550 feet, though the hills are less lofty, is very wild and picturesque. In the Unter-Harz the valleys are more open, the ground freer from wood, the climate milder, and thus cultivation is more general, up to even a considerable height, in some as high as 1800 feet. The Ober-Harz is scarcely fit for tillage, but it abounds in rich metallic deposits, and it has fine woods. The group is bounded on the north and east by the level North German plain; on the south-east it falls away into the high Eichsfelder plain; on the south, from Duderstadt to Nordhausen, it is separated from the Ohmberg by a narrow valley called the Eichsfelder gate; on the south-west it is connected by the Rotheimberg and other low ridges to the Thuringerwald; on the west in like manner with the Sollinger-wald. The mineral products are gold, silver, copper, lead, iron, and marble; there is also stone coal in some places, and many salt springs. There is likewise much good pasture, and honey and dairy produce are sources of wealth. The people number about 30,000 in the Ober-Harz, and 40,000 in Unter-Harz. The highest inhabited place is Andreasberg, which is 1997 feet above the sea-level. The Brocken, 3716 feet high, is the loftiest summit. The rivers which flow from the Harz are, to the Weser, the Ocker, Radau, Ilse, Ecker, Innerste, Nette, Söse, Siebe, and Oder; to the Elbe, the Zorge, Helme, Wimper, Eine, Selke, Bode, and Holzemme.

HAS'DRUBAL ("helped by Baal"), a favourite name at Carthage. The two best known individuals of the name are the brother-in-law and the brother of Hannibal. The first went to Spain with the great Hamilcar Barca (Hannibal's father), whose daughter he had married. From 236 to 229 B.C. he was his chief lieutenant. When Hamilcar died in the latter year Hasdrubal took his position, and for eight years was uncontrolled viceroy of the Carthaginian state in Spain. He was a born statesman, and the conquests of Hamilcar were first turned into real acquisitions by him. Cities and palaces arose here and there, the chief of them being New Carthago (Cartagena); the fierce native tribes were skilfully handled by a mixture of force and diplomacy, and converted into fairly loyal subjects. The whole of Spain was a flourishing Carthaginian state as far north as the Iberus (Ebro), and so entirely was it Hasdrubal's creation that the famous treaty, whence afterwards the second Punic War was to spring, was made with him, and not with Carthage, by the Romans. This treaty fixed the Iberus as the boundary in Spain between Rome and Carthage. In his military enterprises Hasdrubal used his young brother-in-law Hannibal, whose great talents

as a general he quickly perceived. He fell by assassination at the hands of a revengeful slave, B.C. 220, and his command was assumed by Hannibal.

Hannibal's brother Hasdrubal was left by the great general in Spain when he marched upon Italy at the beginning of the second Punic War. Here he contended with fair success against the two Scipios. Eventually, in the autumn of B.C. 207, he started for Italy to join Hannibal and assist him, the selfish policy of Carthage refusing to send him succour from Africa. He met the Roman forces on the Metaurus in Umbria, near Sena Gallica. He was hastening southwards to Hannibal, who awaited him at Canusium in Apulia. His despatches had been intercepted and this arrangement detected, and the Roman consul Nero had had the rare temerity to rely upon Hannibal's keeping his tryst, so that he ventured to hurry forward with some 7000 men to reinforce the consul Marcus Livius at Sena. Hasdrubal was led into a bad position by guides in his endeavours to turn the flank of the Romans, and after a severe and bloody battle he was forced to succumb. As soon as he saw that all hope was over he dashed into the midst of the enemy and perished, B.C. 207. His plan of battle, conceived under crushing difficulties, was admitted by the Romans to be very fine, and he seems indeed to have been a worthy brother of Hannibal in all respects. Nero had the brutality to fling his gory head into Hannibal's camp by way of communicating what had occurred. So swift had he been that Hannibal had not discovered his absence with the greater part of his army.

One of Hannibal's best officers was also a Hasdrubal, and one of his brother Hasdrubal's best colleagues in Spain was another Hasdrubal, son of Gisco. It is indeed necessary in considering Spanish affairs of the time to distinguish between them as Hasdrubal Barca and Hasdrubal son of Gisco. The latter fought also against Scipio in Spain in the last great struggle of the devoted city, B.C. 204, just before Hannibal's recall and the fatal day of Zama. He was not successful, and the ungrateful Carthaginians condemned him to death. Hannibal reversed the sentence on his arrival, but Hasdrubal Gisco had tasted too deeply of the bitterness of disappointment and took poison. Finally, it was a Hasdrubal that attempted to defend the defenceless Carthage against Scipio Africanus Minor in the third Punic War, 149–146 B.C., and who surrendered the city to the ruthless conqueror. He figured in Scipio's triumph as the price of his life, and was allowed afterwards to live in retirement in Italy.

HASH'ISH is the name given in the East to a preparation of the resin of the Indian hemp plant, used for the purpose of producing intoxication. In Central India, where it exudes freely during the hot season, the resin is collected by men clad in leathern dresses, who rush through the fields and brush violently against the plants, coming out covered with the sticky juice, which is afterwards scraped off and dried. In other districts a similar process is pursued, with the exception that clothes of any kind are considered superfluous. The most common form of hashish, however, is obtained by boiling the leaves and flowers of the plant in water to which fresh butter has been added. The decoction is evaporated to the thickness of a syrup, strained, and then mixed with spices, sugar, &c., to disguise its unpleasant taste. The delirium caused by a large dose of hashish is of a very peculiar character, and one that to Orientals is especially pleasant. This is proved by the fact that some form of the drug is habitually used by over 200,000,000 of the human race. Dr. Moreau of Tours, in his work "Du Hachisch et de l'Alienation Mentale," published in 1845, gives a glowing account of what he calls the *real happiness* produced by its use, and a still more highly coloured account of its effects may be found in Bayard Taylor's "Pictures of Palestine."

By Orientals hashish is sometimes mixed with other drugs to form an aphrodisiac, and it is occasionally used to produce a feeling of homicidal mania. Ever since the time of the crusaders this preparation has been given to soldiers to render them indifferent to death, and when a Malay desires to close his existence by "running a muck," that is, killing indiscriminately every one he meets until he is himself slaughtered, he generally prepares himself beforehand by a full dose of hashish. See also ASSASSINS and CANNABIS.

HAS'SAN and **HUS'SEIN** (or *Hasan* and *Hosain*) were the grandsons of Mohammed, whose daughter Fatima married Ali, her father's first cousin. Ali eventually came to the caliphate in 655 A.D., after Abu Bekr, Omar, and Othman had in turn reigned; and the throne seemed now as it would pass securely to the actual descendants of the prophet. But since Mohammed's death grave deficiencies had been proved to exist in the Koran as a complete code of laws and conduct, and to supply these a supplementary code was added, somewhat as the Talmud supplements the Old Testament among the Jews; and this code or *Sunneh* (traditions) was made up partly of oral traditions from Mohammed, but still more of Jewish, ancient Arabian, and other observances. Ali refused to acknowledge the *Sunneh*, although it was attempted to foist it off as having the authority of Mohammed, and the *Shias* (Sectarians), whose sect he thus inaugurated, think as bitterly of the *Sunni* (Traditionalists) as the Protestants used to do of the Roman Catholics, whose additions to the true faith they claimed to prune away. Ali himself, like Henri Quatre, submitted somewhat to the Moslem orthodoxy, but at least 12,000 Shias (or as they called themselves Kharejiyeh, Separatists) split off from what they held to be the compliance of a renegade. Not only so, but in their fierce resentment at the contests desolating Islam, they determined to assassinate the three chief causes of them, Ali the Caliph, his great Damascus opponent Moawiya, ruler of Syria, and a third, prince Amr. Three fanatics were told off for the work. Amr, however, escaped, as it happened that an officer was at that time filling his place, and was murdered in his stead; Moawiya recovered from his dangerous wound; Ali alone perished, stabbed at the very door of a mosque in Kufa, A.D. 660. The site of the fine mausoleum erected over his remains, and called *Meshed Ali*, the tomb of Ali, now bears a town venerated by the Shias as a place of pilgrimage. Ali's assassination reinstated him as the Shia saint.

What follows is the subject of the famous passion play of Persia, "The woes of Hassan and Hussein, grandchildren of the great prophet." Hassan became caliph at his father Ali's death, but had almost at once to resign in favour of his competitor Moawiya, A.D. 661, under a promise of the succession after the latter's death. But the new caliph caused Hassan to be murdered by his own wife, A.D. 668, and at Moawiya's death his son Yezid succeeded, A.D. 680. But Hassan's brother Hussein still lived, and a formidable plot was not long in being organized. Yezid acted vigorously, intercepting and slaughtering Hussein's envoys whenever they appeared, by means of officers planted in all directions; and finally one of these, Obeidallah, caught the Imam Hussein himself on the frontiers of Babylonia, enticed him into a plain by the banks of the Euphrates, near Kerbela, and there surrounded him with a considerable force, who put to death Hussein, the two children, his son and his nephew, whom he held in his arms, and all his small escort of followers. The women of the family and one son of Hussein's were spared. This murder of the descendants of Mohammed filled everyone with horror, and Yezid, Obeidallah, and Shimr (the actual murderer) are names held in execration for the crime to this day. It was made the worse by Hussein's having offered to retire to Mecca or elsewhere, and acknowledge in the fullest way the sovereignty of Yezid. The offer

was not even transmitted to Obeidallah by the ferocious Shimr.

An abridgment, in two 8vo volumes, of the great passion play of "Hassan and Hussein" has been published by Sir Lewis Pelly (London, 1879); but the almost interminable original lasts many days in the acting. A fortnight is the least time possible. There are numerous episodes, and each of them is elaborated to the fullest extent. It is acted throughout Persia (the established religion of which is Shiite) in the month Moharam, by numerous travelling companies. Near the great towns visitors, even Christians, are tolerated; but on the frontiers the ancient half-sacred character of the performance prevails, and strangers are rigorously excluded, except personal guests of the khan who has ordered the performance. The people assemble in thousands on some hillside, or on the town walls, and as they know the main points from their youth up they follow the play with the intensest interest. At certain points it is the etiquette to weep, and those who are unable to follow the majority of actual weepers hold their handkerchiefs before their eyes. When, however, the crowning scene of the murder of Hussein and the boys is reached, the shouts of horror, sobs, and cries are only too genuine, and the actors of the villainous characters sometimes go in danger of their lives. Not a year passes without a serious and occasionally a fatal accident of this kind in Persia. Everything is done in the most realistic fashion, men are apparently beheaded, drawn, and quartered in full sight of the audience, by help of lay figures and the viscera of freshly killed sheep. Each day's performance generally concludes with frantic religious dancing, the dancers whirling round with a kind of waltz step and clapping their hands, or swaying to and fro in long lines, each grasping the sash of his neighbour with his left hand, while with his right he beats his breast, vociferating the names of the two blessed Imams at each step till he falls exhausted and another takes his place. Late into the night the rhythmic cry, "Hassan, Hussein; Hassan, Hussein," continues without an instant's pause.

HAS'SE, JOHANN ADOLF, though now hardly known except to musical antiquarians, was in his day one of the most popular composers. This may be judged of by the fact that he was invited to remain in London when he visited England in 1739, to conduct the opera just established in opposition to Handel. His answer does honour both to his estimate of himself and of his great contemporary; it was simply, "Then Handel, I suppose, is dead." It was two of Hasse's most famous airs that Farinelli used to sing nightly to the melancholy Philip V. of Spain, for ten years at one stretch. It is almost a pity that Hasse is so rarely heard, for much of his work is still charming, and well repays performance.

Hasse was born in 1699, near Hamburg, his father being an organist. As a youth he was engaged as tenor singer at the opera of Hamburg by Keiser, in whose band Handel had played. Desiring to become a composer he went to Naples, to the great teachers Porpora and Scarlatti, in 1724. He began his long series of operas with the very successful "Sesostrato" in 1726, and at once became the idol of Italian musical circles. His nickname, *il caro Sassone* (the beloved Saxon, quite near enough for Hamburg in Italian geography), has stuck to him firmly. In 1729 he married the famous singer Faustina Bordoni, who had sung in England for two seasons and caused a furore, and who was as great a favourite with the Italians as her husband; and both were summoned to the musical court of Dresden in 1731, where they remained thirty-two years, Hasse occasionally visiting other countries. In 1760 the siege of Dresden ruined Hasse's patron and himself alike, but in 1763 he was at Vienna courageously writing, old as he was, in successful rivalry with the growing genius of Gluck. He lived to prophesy the future eminence of Mozart ("This boy will throw us all into the shade"), and died at Venice in 1783. Faustina died a few months before him. Probably no musical composer ever had such uninterrupted success as Hasse; a hundred operas and a crowd of other compositions flowed from his pen amid universal delight. Writing exactly to the taste of his epoch as he did, Hasse has lost the applause of posterity, though he was idolized by his contemporaries.

HA'STINGS, a parliamentary borough, market-town, and famous watering-place of England, in the county of Sussex, 74 miles S.E. from London by the South Coast Railway, and 64 by the South-eastern, is situated on the coast in a narrow valley opening between lofty sand-hills to the sea. It was originally one of the settlements of the Saxon Hæstingas, and soon rose into importance as a maritime town. Under Edward the Confessor it became a member of the Cinque Ports. The chief event in its history was the landing of the Conqueror, who encamped here previous to his march upon Battle. The castle, a Norman building, was probably erected by the Count of Eu, but lapsed to the crown about the middle of the thirteenth century. The ruins, including the castle chapel and some towers, now belong to the Pelham family. The town gradually declined until toward the end of the last century, when its sheltered position and genial climate recommended it as a sanatorium for invalids. It is now one of the most popular resorts, next to Brighton, on the south coast, and forms with its handsome suburb of St. Leonard's an uninterrupted succession of well-built terraces. The Marine Parade stretches westward along the sea-front of the town, and is joined and continued by the Grand Parade of St. Leonard's—forming one of the finest sea walks in the kingdom. A splendid pier, which had been three years in construction, was opened in 1872. It is 910 feet in length; its width varies from 45 feet to 190 feet, and it is 30 feet above the sea-line. At the head of it is a large and handsome saloon, capable of containing 2000 persons. The drainage is good, and the sewage is carried a long distance out to sea. The town is also well supplied with water. The Alexandra Park—a beautiful pleasure ground 77 acres in extent—was opened by the Prince and Princess of Wales in 1882. The churches are uninteresting. The grammar-school was founded in 1610. The chief public buildings are the town-hall, baths, libraries, assembly room, theatre, literary institution, and convalescent home for children, opened in 1882. The school of art, a spacious Gothic building, was presented to the town by Mr. T. Brassey, M.P., in 1878. There is a memorial of the Prince Consort, consisting of a drinking fountain and clock tower, with a statue of the prince in a niche. It serves as a sea-mark. The suburbs are very beautiful, furnishing delightful drives and walks. There is a Roman Catholic training college and convent at St. Leonard's. The trade of Hastings seems, from the charters, to have once been very extensive, and its port was anciently protected by a pier, destroyed by a storm in the reign of Elizabeth, and not rebuilt. Considerable quantities of fish are caught and sent to the London market; a good deal of boatbuilding is also carried on, and lime is extensively produced in the neighbourhood, but its prosperity depends chiefly upon its well-deserved reputation as a watering place. The municipal government of the town, which was vested in a mayor and twelve other jurats, and regulated by the charter of the Cinque Ports (20 Charles II.), and by one peculiar to itself (30 Eliz.), is now, under the Municipal Reform Act, committed to six aldermen and eighteen councillors, from among whom the mayor is chosen, the town being divided into six wards. Hastings returns one member to the House of Commons since 1885. The parliamentary and municipal limits are nearly conterminous, and include part of St. Leonard's. The population in 1881 was 47,738.

HASTINGS SERIES compose the lower group of the Wealden beds; they lie under the Weald clay, and consist largely of clays and sands with bands of limestone. They are subdivided into Tunbridge Wells sand, Wadhurst clay, and Ashdown sand. These form an aggregate thickness of from about 600 to 1000 feet. The fossil remains are abundant and of that varied character usually found in delta formations.

The Hastings sand is locally used for building purposes; it is not very coherent when first quarried, and although it hardens on exposure it is not a durable stone. It has a yellowish or brownish colour, the sand grains being held together by a somewhat ferruginous paste.

HASTINGS, FRANCIS RAWDON, EARL OF MOIRA and MARQUIS OF, was born in Ireland in 1754, and educated at Oxford. On the breaking out of the American War, having previously made choice of the military profession, he embarked for the scene of action. In 1778 he was nominated adjutant-general of the British army in America, with the rank of lieutenant-colonel. Here he was engaged in most of the desperate combats which have been recorded in the history of that unfortunate struggle—as the battles of Bunker's Hill, of Camden, Hobkirk Hill, &c. On his return to England he was created a British peer, and was afterwards despatched to Holland with 10,000 men to aid his Royal Highness the Duke of York. In 1803 his lordship was appointed commander of the forces in North Britain. Shortly afterwards he received the important office of governor-general of Bengal, and at the same time he was appointed commander-in-chief of the army in the East Indies, which he held until 1822. His next appointment, after his return to England, was as governor of Malta, in which situation he died in 1826.

No governor-general ever held power in India for so long a time, or with more wisdom, energy, and moderation. In his civil administration he was tolerant to the prejudices of the natives and favourable to the advancement of knowledge. Under his rule and directions the formidable contests with the Marhattas, the Pindarees, the Nepalese, and other hostile foes, were brought to a favourable conclusion, and the subjugation of our Indian territories consolidated.

HASTINGS, WARREN, the chief founder and organizer of the British Empire in India, was born on 6th December, 1732, and, after receiving the usual education at Westminster School, went out in 1750 as a writer in the service of the East India Company. After residing about fourteen years in India, he returned home with a moderate fortune. In 1769 he received the appointment of second in council at Madras, and in 1772 was appointed president of the Supreme Council of Bengal. His powers were enlarged by the alteration of the Indian constitution by Act of Parliament, in virtue of which he became, 1st January, 1774, governor-general and supreme head of all our Indian dependencies. Affairs were at this time in great disorder, and of the four members of the supreme council three were his determined opponents, and constantly outvoted his proposals. In spite of the latter circumstances Hastings persisted in his own policy, and in the end obtained almost absolute power. One of the first acts of his new position was to lend the services of the company's army to Sujah Dowlah, the nabob of Oude, for the subjugation of the Rohillas, an independent Mohammedan people, for a bribe of £400,000. This act was condemned by the three members of the council, and they encouraged a Brahman named Nandkumar to charge him with corruption. This man Hastings caused to be arrested on an old charge of forgery, on which he was tried by an English jury, found guilty, and hanged 5th August, 1775. By this act, which terrified his opponents, Hastings recovered his ascendency, and the death of one of the members of the council and the retirement of another soon afterwards, enabled him to carry out his plans without undue interference. When the war broke out with France he promptly occupied all the French settlements in India, and in the conflict with Hyder Ali he acted with such decision and vigour as to check the victorious advance of that prince, and finally to break his power altogether. Pressed for money to meet the expenses of the war, he exacted immense sums from Cheyte Sing, the rajah of Benares, and soon afterwards seized and annexed his territory. The begums or princesses of Oude were next assailed, and ultimately the accumulated treasure of the family, which had been stored in the "Beautiful Dwelling" at Fyzabad, was drawn upon by him to the extent of £1,000,000 sterling. Notwithstanding these services, he had given satisfaction neither to the home administration nor to the court of directors. The public ear was offended by rumours of cruelty, corruption, and unjust aggression; the directors censured the lavish and corrupt expenditure, and the independence of his conduct. Repeated attempts were made to obtain his dismissal, but these were uniformly defeated by the conrt of proprietors. Thus supported, he carried matters with a high hand, neglected or positively refused to obey the orders sent by the directors, and practically exercised an absolute and irresponsible power until February, 1785, when he resigned his office and set sail for England. On his arrival he was received at court and elsewhere with great favour, and it was thought that rewards and honours—a peerage among them—would be lavishly conferred on him. But by and by, instead of recompense, arose a murmur about punishment, and then that celebrated indictment was prepared, that notable process begun, which afforded Burke, Fox, and Sheridan an opportunity for the display of their eloquence, but which in other respects was entirely fruitless. In the session of 1786 articles of impeachment were brought forward by Mr. Burke, charging him with the oppression and final expulsion of the Rajah of Benares, the maltreatment and robbery of the begums of the house of Oude, and the charges of receiving presents and conniving at unfair contracts and extravagant expenditure. The sessions of 1786–87 having been consumed in preliminary proceedings, the House of Lords assembled in Westminster Hall, 13th February, 1788, to try the impeachment, and on the 15th Mr. Burke, in the name of the Commons of England, opened the charges against the prisoner in a speech which lasted upwards of three days. [See Burke.] He was assisted in the management of this cause by Fox, Sheridan, Grey, and others. The sessions of 1788, 1789, and 1790 were consumed in going through the case for the prosecution. In 1791 the Commons expressed their willingness to abandon some part of the charges, with the view of bringing the trial sooner to an end; and on the 2nd of June, the seventy-third day, Mr. Hastings began his defence. This was protracted until 17th April, 1795, on which day (the 148th), after a lingering trial of seven years, he was acquitted by a large majority of the House of Peers on every separate article charged against him.

Mr. Hastings attempted to refute the charges of extortion by publicly asserting, in the most solemn manner, that never at any time of his life was he worth £100,000. The law charges of his defence amounted to £76,080. In March, 1796, the company granted him an annuity of £4000 for twenty-eight years and a half, and lent him £50,000 for eighteen years, free of interest. He retired completely from public life to an old family estate which he purchased at Daylesford in Worcestershire. He died 22nd August, 1818. Hastings, whose enterprises were so gigantic, was small in stature, but vigorous in frame. His chief misfortune was that, born a gentleman and educated a scholar, he had to begin life as a commercial adventurer;

government was to him an audacious commercial speculation, which he strove in vain to hide by viceregal splendour.

HAT, the most common head-covering of both sexes, distinguished by its possession of a brim from the cap or bonnet. Hats are made of silk, fur, wool, straw, and many other materials. The curious art of felting is believed to have been brought to Western Europe by the crusaders. Wool was the material first used in making felt hats; but in time, as trade with America became developed, it was partly superseded by the fur of the beaver, and for many years fine beaver hats, in the manufacture of which great skill and care were required, were worn by the higher and middle classes in Great Britain. About the year 1830 it was estimated that 1,000,000 beavers were annually killed to supply the hat trade in Europe. This led to a great scarcity of beaver fur, and to the substitution of silk, which now forms the most important article in the manufacture of hats. The silk hat consists of a body and rim usually made of two or three layers of cotton cloth, saturated with varnishes to give the fabric stiffness, and make it waterproof. These are moulded on wooden blocks according to the fashion of the day, and then the shape is covered with lac and dammar varnish, and the fine silk plush is applied with great nicety, so as to make it adhere in every part, and to render the seam as imperceptible as possible. It is then trimmed with silk braid on the edge of the brim, and a silken band round the junction of the body with the brim, and a lining of leather and silk put in to complete the hat. Plush is largely made in England for covering silk hats; but the best, for the so-called "Paris hats," comes from France. Lightness, gloss, and durability are the chief qualities of this kind of hat, but it is easily damaged, and quite unsuitable for rough wear in travelling or out-of-door pursuits. The manufacture of felt hats is carried on very extensively in this country by the aid of machinery, which was first introduced in America. The material of these hats is chiefly wool, though a certain proportion of fur is used in some kinds to improve the appearance of the external surface, as in the case of the old beaver hats. The material is felted and shaped on metal moulds by the aid of heat, moisture, and pressure, the former being supplied by passing steam through the apparatus employed. The hats are then dyed and, if necessary, stiffened with shellac, and they are finally trimmed, as in the case of silk hats. The production of hats and bonnets from plaited STRAW will be treated under that heading.

HATCH'MENT (for *Ach'ment*, a shortened form of *Achievement*) is the fully complete (achieved) armorial bearings of the higher classes, placed in front of the house after death, to set forth their rank. The form of a hatchment is square, surrounded by a raised black border; and it is suspended from one corner, so that it hangs lozenge fashion. A funeral escutcheon is a similarly bordered piece of cloth, oblong, which is used for draping horses and decorations. In both the centre is occupied with the full armorial bearings of the deceased. If the deceased be a bachelor, maid, widow, or widower, the whole ground round the arms is painted black; if a husband, the dexter half of the ground is black; if a wife, the sinister. But the black ground never touches the arms of an *office*, because that is in its nature not mortal. A bishop, therefore, who bears his own arms impaled with those of his see, would have the ground black only on the side of his personal arms, even though a bachelor or a widower. If the crest is dark and could not otherwise be well seen, a little white space is left round it for the sake of clearness. If the deceased is the last of his family the death's head, according to the rigid rules of heraldry, should supply the place of the crest.

HATCH'WAYS are openings in the deck of a ship, leading from one deck to another, and generally used for hoisting or lowering goods. The number of hatchways varies according to the size and use of the ship, being most numerous in merchant vessels and barges.

HAT'FIELD or **BISHOP'S HATFIELD,** a town of England in the county of Herts, is 18 miles from London by the Great Northern Railway, and about 6 W.S.W. from Hertford. The manor of Hetfelle (as it is called in Domesday) was granted by King Edgar to the abbey or monastery of St. Ethelred at Ely, and upon the erection of that abbey into a bishopric in 1108 is supposed to have acquired the designation of Bishop's Hatfield. The bishops of Ely had a palace at Hatfield, which, with the manor, was made over to the crown in the time of Henry VIII.; the palace was the residence of Prince Edward, afterwards Edward VI. Elizabeth held her first privy council here. In the succeeding reign James I. exchanged the manor of Hatfield with his minister, Robert Cecil, marquis of Salisbury, for the manor and park of Theobalds. Its new master erected the present magnificent quadrangular mansion, which is one of the finest specimens of the baronial buildings of that age in the kingdom. In 1835 a portion of the palace was destroyed by fire, in the flames of which the Dowager-marchioness of Salisbury perished; but it was shortly afterwards restored with great taste, and in exactly the old style. The town of Hatfield is situated on the slope of a hill, and has a neat and clean appearance. The parish church is handsome, and has for two centuries been used as the burial-place of the Salisbury family. The Salisbury chapel was elaborately restored in 1877. There are several district churches in the neighbourhood, and the town contains places of worship for Baptists and Congregationalists. The trade is unimportant. Near Hatfield is Brocket Hall, in which Lord Palmerston died in 1865. The population of Hatfield in 1881 was 6502.

HAT'TI SHERIF' ("exalted writing"), the name of an irrevocable decree of the Sultan of Turkey, bearing his cipher, and promulgated in the most solemn manner. The most famous hatti sherif is that of Abdul Medjid, 1839, guaranteeing protection to all his subjects without distinction of creed. Another title is *Hatti Humayun.*

HAUR'AN (the ancient *Bashan*), a district of Syria, east of the Jordan and south of Damascus. It extends south from the base of Hermon to the confines of the Arabian Desert. The general elevation is 2000 feet above the sea-level, or 3298 feet above that of the Dead Sea; the formation is entirely of igneous rocks, chiefly dolerite and various porous slag-like traps, all of which, when decomposed, make a very rich and fertile soil, though the climate is dry. One large district near the middle, called the Lejah, is so thoroughly strewn with loose sharp rocks of this volcanic character as to be almost impassable. This is the *Trachonitis* of the Greeks and the Hebrew *Argob.* The plateau is traversed by several mountain ranges: Jilad (Gilead), Es Zumleh and Kafkafa, and the Jebel Hauran in the south, lat. 32° to 33°. The Jebel Hauran is the highest group, rugged and lofty, and the heights reach from 4000 to 6000 feet. In the north-west, to the east of Damascus, are the Jebel Mania and other ranges less elevated. South-east of Damascus there are several lakes receiving rivers, but without outlets, the lakes Atebeh, Hijaneh, Bala, and others smaller. The region is inhabited chiefly by the Bedouins and some colonies of Druses; it is full of the remains of ancient cities, chiefly those of the Greek and Roman period, tombs, and various monuments. A few of the streams seek the Eastern Desert and are lost. Most of the drainage is to the Jordan valley by the Yarmuk and other streams. The region at the present time is generally arid, though under irrigation it may be made, as in ancient times, a rich and populous country.

HAUS'ER, KASPAR, a remarkable foundling whose mysterious history and fate excited great curiosity in the early part of the present century. He was first observed

in the streets of Nuremberg, on 20th May, 1820, when he was dressed as a peasant and appeared to be about sixteen or seventeen years of age. His helpless and bewildered appearance attracted the attention of the townspeople, and he was found to be in possession of two letters which said he was the son of a cavalry officer, and that he had been brought up in seclusion. He was found to be on examination broad shouldered and well proportioned, with a very fair white skin, but almost unable to walk, only able to speak a few words in Bavarian, and apparently totally unacquainted with the ordinary usages of life. At first imprisoned as a vagrant he was afterwards educated by the authorities, and as he became able to communicate with others, he said he had been brought up in a dark place underground, clad only in a shirt and trousers, and that he saw only one man, who for the most part brought him bread and water and cleansed and dressed him when he was asleep. During the latter period of this imprisonment the man had taught him to walk and to write his name, but he had never been out in the daylight before he was brought to Nuremberg. Under the care of Professor Daumer he made some progress in education, but it was observed that the abnormal acuteness of his sense perceptions, curiosity, and strength of memory decreased as his knowledge became more extensive. In October, 1829, he was found suffering from a wound on the head, which he said had been inflicted by a man with a black face, but the wound was a slight one and he recovered. Earl Stanhope, who visited him, sent him to Ansbach to complete his education, and there he was appointed to a clerkship in the office of appeal, which he retained until his death. This was as mysterious as his life, for on 14th December, 1833, he came home from the palace garden with a mortal wound in the breast. He declared he had been decoyed there by a pretended message from Lord Stanhope, and there stabbed by a stranger. He died three days afterwards, 17th December, 1833. See Daumer, "Mittheilungen über Kaspar Hauser" (Nuremberg, 1832); Fuerbach's "Kaspar Hauser Beispiel eines Verbrechens am Seelenleben" (Ansbach, 1832); and the *Allgemeine Zeitung* of 3rd June, 1875.

HAUS'MANNITE, one of the ores of manganese, is of a brown black colour, with a specific gravity of 4·72, and hardness of 5 to 5·5. It is composed of protoxide and sesquioxide of manganese ($MnO.Mn_2O_3$). It crystallizes in the tetragonal system in pyramids, which are frequently twinned, hemitropism having taken place along the twin plane. It also occurs massive and granular.

HAUT'BOIS. See OBOE.

HAU'YNE is a silicate of alumina and soda with sulphate of lime, $2CaSO_4+3(Na_2OSiO_2+Al_2O_3SiO_2)$. It has a bright blue or greenish-blue colour, and crystallizes in the cubic system. It occurs mostly in basalts and allied volcanic rocks, and is an essential constituent of hauynophyr and hauyninite.

HAVA'NA or **HABA'NA,** a flourishing commercial city, with the best harbour in the West Indies, or perhaps in the world, stands on the north coast of the island of Cuba, and in 1884 had a population of 240,000, of whom 60,000 were blacks or mulattoes. A channel half a mile long, 350 yards broad, 8 to 10 fathoms deep, and without bar or obstruction of any sort, leads to the harbour, which is formed by a magnificent bay nearly 3 miles long and half as much in width, sheltered by hills from every wind, and capable of accommodating 1000 ships of the largest size, vessels of the greatest draught coming close up to the quays. The city is built along the entrance to, and on the west side of, the basin. The streets are here narrow and dirty, but in the suburbs, which are larger than the city, they are wide and well laid out. The houses are very solidly built, with one, and very rarely two storeys, and enormous windows which, instead of casements, are provided with bright-painted iron gratings. The number of hackney coaches and private equipages is very remarkable, the former being estimated at upwards of 6000. The entrance to the harbour is defended by two strong fortresses, El Morro and La Punta, and a continuous series of batteries runs along both shores. The city also, which is entered by three gates, is defended by a strong citadel; and fortifications have been erected on all the neighbouring heights. Among the finest public buildings is the cathedral, in which the remains of Columbus now lie, having been removed hither from San Domingo in 1795. The opera-house is one of the most magnificent in the world. Havana is the seat of a bishop, has a university, with medical and law schools, an ecclesiastical college, theatres, a botanic garden, museum of natural history, dockyard, and fine promenades, shaded with trees and adorned with fountains. There are railways to the places of most importance in the interior.

A glance at the map shows the great importance of Havana from a political point of view, as it commands both the inlets to the Gulf of Mexico. Among the commercial cities of the western hemisphere it ranks inferior only to New York, and for a long period it engrossed the whole foreign trade of Cuba; but of late years a portion has been obtained by Matanzas, a town about 60 miles east. The cigars of Havana are of world-wide celebrity. It has also manufactures of chocolate, woollen fabrics, and straw-hats. The principal articles of export are sugar, copper ore, coffee, tobacco and cigars, and molasses; other exports are mahogany, cedar, rum, cocoa, cotton, wax, hides, dye-stuffs, fruits and preserves, honey, &c. The imports consist of flour, corn, provisions, wine, cotton goods, linen, hardware and metals, silk, leather, spices, butter, lard, cheese, fish, deals, casks, hoops, &c. The trade of Havana extends to all the countries of Europe and America, but chiefly to Spain, the United States, and England.

In consequence of the heat of the climate, the inhabitants of Havana remain in-doors during the day; but in the evening the delicious promenades (*alamedas*) of the city and its environs present a most animated spectacle, being thronged with the gay and fashionable of both sexes. The people, ethnologically considered, are Caucasian, African, and Mongolian. The Caucasians consist chiefly of the natives of Spain, their descendants constituting about fifteen-sixteenths of the white population. The Africans or negroes constitute about one-fourth of the entire population, and the Mongolians comprise the Chinese immigrants, who have been introduced into the island of Cuba in somewhat large numbers. In 1762 the town, after an obstinate resistance, was taken by an English fleet and army under Lord Albemarle, the fleet numbering 200 vessels and the army 14,000 men. The following year it was restored to Spain under the treaty of Versailles.

HAV'ELOCK, GENERAL SIR HENRY, an illustrious soldier, whose skill and bravery nobly retrieved English honour in British India, was born 5th April, 1795, at Bishopwearmouth, in Durham. He was educated at the Charterhouse School, and in 1813 was entered of the Middle Temple, where his most intimate associate was Judge Talfourd, author of "Ion." His elder brother, Lieutenant-colonel William Havelock, having distinguished himself in the Peninsular War and at Waterloo, he became in turn inspired with the military ardour of his family. A month after the battle of Waterloo he was appointed, by purchase, second lieutenant in the Rifle Brigade; and he had the good fortune, in his military training, to have the assistance of Captain (afterwards Sir) H. Smith, the hero of Aliwal. Having subsequently exchanged into the 13th Light Infantry, in 1823 Havelock departed for India; and in the Burmese War, which broke out in 1824, he was appointed deputy-assistant adjutant-general. He was present at the actions of Napadee, Patanagoh, and Peghan.

Being an accomplished scholar and a linguist, Havelock, in 1827, published the "History of the Ava Campaigns," which was remarkable for the freedom of its comments on the circumstances of the war. Notwithstanding the talents he everywhere exhibited, and the learning he displayed on his passing for languages at the College of Calcutta, he remained for twenty-three years a subaltern. About this period an army was collected for the invasion of Afghanistan. Havelock accompanied the British forces, and was present at the capture of Ghazni and Cabul. He afterwards published a "Narrative of the Afghan Campaign," which was highly appreciated for its style and fidelity. On the second invasion of Afghanistan Havelock was sent to join Sir R. Sale at Jellalabad, and was present at the various encounters with the Ghilzais. He had also the chief direction, under General Sale, of the memorable defence of that place, of which he wrote the despatches, so highly commended by Sir G. Murray. In the crowning attack upon the forces of Akbar Khan and their final defeat, Havelock commanded the right column, and broke the enemy's lines before the main forces of the British could enter into action. For this gallant deed he was made a companion of the Bath, and gazetted to a brevet-majority.

In the following year Havelock was promoted to a regimental majority, and nominated interpreter of the Persian language to the commander-in-chief, Sir Hugh Gough. In 1844 he was promoted to the rank of lieutenant-colonel by brevet. In 1845 he was actively engaged in the war against the Sikhs, and took a conspicuous part in the battles of Moodkee, Firozshah, and Sobraon, in which he had three horses shot under him. He was afterwards appointed deputy-adjutant-general of the queen's troops at Bombay; but twenty-five years of ever-active service beginning to make an impression on his constitution, he visited Europe for the renovation of his health. On his return to Bombay, in 1851, he was made brevet-colonel, and appointed, through the interest of Lord Hardinge, quartermaster-general and adjutant-general of the queen's troops in India. During the short war with Persia in 1857 Sir Henry had the command of the second division, and was engaged in the action of Mohammerah. Peace with Persia was hardly concluded when the sanguinary rebellion of the Indian Sepoys broke out, and Havelock at once hastened to Calcutta, where he was chosen to command a small movable column at Allahabad, to quell the risings in that district and to advance to the rescue of Lucknow and Cawnpore. At the head of about 2000 men he advanced against the rebels, and though opposed by overwhelming numbers he defeated them in eight battles, took about 100 pieces of cannon, recaptured Cawnpore, though he was unable to prevent the massacre of the women and children there, and moved on towards Lucknow, until the diminished state of his forces compelled him to retire. Reinforced by General Outram, who generously refused to supersede him in command, he fought his way through to Lucknow, but was besieged there by the mutineers until the place was finally relieved by Sir Colin Campbell. A few days after the final relief Havelock died of dysentery, 22nd November, 1857. A pension of £1000 a year was granted to his widow, and a baronetcy and a pension of a similar amount was given to his son. A brave and able soldier, he is perhaps more celebrated for his pure, strong religious faith.

HA'VER, in Scotch law, is one who holds a deed, writing, or other document required in a cause, either for inspection or in evidence, and who is called upon to exhibit it judicially. The right of litigants to call on third parties to produce documents in their possession is regulated by the same principles as those which compel their attendance as witnesses. The law of Scotland affords the most ample means for enforcing production, or at least exhibition, of documents required by litigants for the due ascertainment of their rights. Both plaintiff and defendant must with their pleadings produce all documents on which they found, if in their possession, and in trials by jury all documents on which either party intends to found must be lodged in court eight days before the trial. When therefore a judge allows a proof or appoints a case to be tried, he at the same time that he grants diligence for citation of witnesses includes in it a power to summon havers, for the purpose of producing documents; indeed the interlocutor allowing proof or ordering trial is now of itself sufficient warrant to cite havers as well as witnesses. Before even the case is set down for trial, and during the preparation of the pleadings, the court may, on cause shown, order either party to produce documents in his possession or within his power, and may grant diligence against third parties to compel production of documents. Parties cited as havers must either produce the documents or depose where they are or where they suppose they are, how if they once had them they came to lose them, and generally give such information as they can to enable them to be traced out. Confidentiality as a ground for non-production is not readily sustained, and never to the effect of defeating the ends of substantial justice. When business books or the like are called for, the judge or commissioner taking the examination of havers will, to save unnecessary publicity or inconvenience, appoint extracts of what is necessary to be made and lodged in court.

HAV'ERFORDWEST (called by the Welsh *Hwlfordd*) is the capital of the county of Pembroke, and a municipal borough of Wales. It is situated on the West Cleddau, 14 miles S. by E. from Fishguard, and 276 from London by the Great Western Railway. The streets are narrow and steep, but well paved and clean, and the town contains many excellent residences. The Church of St. Mary, a fine cathedral-like structure of pointed architecture, surmounted by a large square tower, was restored and decorated in 1861. St. Martin's, an extensive and lofty building, apparently a former appendage to the castle, has a tower and spire. The whole building was thoroughly restored in 1865. There is another parish church and several dissenting chapels. The grammar-school is a handsome building. There are also a school of industry, literary institute, hospital, and lunatic asylum. There are the remains of a castle built in the fourteenth century. The river is navigable at spring-tides to Haverfordwest, for vessels of 100 tons burden; at neaps, for those a little above 30 tons. There are some exports of grain, coal, cattle, and butter. The municipal borough is governed by four aldermen and twelve councillors. Haverfordwest, along with Narberth and Fishguard, formerly returned one member to Parliament, but was merged in the county in 1885. The population in 1881 was 6398. Haverfordwest is a county in itself, and was anciently the capital of the Flemish possessions in Pembrokeshire. Its castle was erected by Gilbert de Clare, first earl of Pembroke, in the fourteenth century.

HAVER'SIAN CANALS. See Bone.

HAVRE, LE, or **HAVRE-DE-GRACE**, a large commercial town and fortified seaport in the department of Seine-Inférieure in France, stands in a low marshy spot on the southern shore of the English Channel, at the embouchure and on the right bank of the Seine, and is distant by railway 134 miles from Paris, and 24 west from Rouen. It had 105,867 inhabitants in 1882. On the decline of Harfleur in the latter half of the fifteenth century, Louis XII. in 1509 laid the foundation of Havre, threw up some fortifications, and built two short jetties. His successor, Francis I., by the sums he expended on the town and the great privileges he conferred upon it, is however to be looked on as the true founder of Havre. In his reign the new city was in great measure built, the harbours improved, the town-hall and the ramparts erected, and the Tower of Francis I., which still exists, constructed

for the defence of the harbour. In 1562 the Prince de Condé betrayed the town to Queen Elizabeth. who garrisoned it with 6000 troops under Dudley, earl of Warwick. The English were forced to capitulate in 1563, but carried away as a memorial of their occupation the archives of the town. Louis XIII. added to the fortifications, and built a citadel, which was afterwards rebuilt on a new plan by order of Cardinal Richelieu. Under Louis XIV. the extent of the town was nearly doubled; part of the fortifications and the old gate of Ingouville were demolished, a new quarter built, and the citadel converted into an immense military quarter, which comprised an arsenal, governor's residence, ammunition stores, and large barracks, forming together a spacious and handsome square round the Place d'Armes. Other fortifications were afterwards erected, but as they became a nuisance from the obstruction they presented to the extension of the town, they were demolished, and Havre absorbed the neighbouring communes of Ingouville and Graville l'Heure.

The town is entered by several gates with drawbridges, of which the Porte Royale, in form of a triumphal arch, is the most remarkable. The old part of the town, which is built round the harbour, presents regular but narrow streets. The wooden houses, of which it was formerly composed, have gradually given way to more solid and sightly structures. The new part is built on a regular plan; the streets are wide, cross each other at right angles, and present several handsome houses. The principal street in Havre is the Rue de Paris. There are few buildings that call for special notice; besides those already mentioned may be named the church of Notre Dame, the city hall, mansion-house, law courts, custom-house, exchange, the great tobacco factory on the Quai d'Orléans, the bonding warehouses, the public library, which contains about 40,000 volumes, the theatre, and the Frascati baths on the sea-shore. Tribunals of first instance and of commerce are held in the town, which has also a chamber of commerce, a naval school of the first class, a school of applied geometry, several insurance offices, &c.

A singular local phenomenon respecting the tide, which rises at Havre to 20 and even 27 feet, gives an important advantage to the harbour. It results from the position of the harbour with respect to the Seine. The tide, having reached its maximum, continues *full for three hours*, in consequence of the strong current of the river damming up the water in the channel formed by the jetties; and this exception to the general tidal law gives vessels leaving the harbour time to reach the sea, even against a head wind, in a single tide. The fine quays which border the docks are always lined with vessels, and present a scene of great business activity.

The harbour of Havre is one of the most accessible in France. It is entered by a narrow channel, formed by two long jetties, which run nearly east and west, and are built between two banks of shingle. Owing to the current little dredging is required. The channel leads to the outer harbour, which has capacious wet docks. The largest is L'Eure, which contains 700,000 square feet. An immense dry dock has been made to obviate the necessity of sending large steamers to Southampton for repairs.

Havre has become the Liverpool of France as the principal port of communication with transatlantic countries. It receives the greater part of all the cotton imported into France, ships most of the French exports to America, and, generally speaking, possesses about a fifth of the entire trade of the country. The imports consist chiefly of cotton, spices, coffee, tea, sugar, timber, coal (from England), &c.; and the exports of French manufactured goods, wine, brandy, oil, jewelry, provisions, &c. It has direct communication with Great Britain, Holland, Hamburg, Portugal, Mexico, Brazil, United States, and India. The total number of vessels which annually enter and clear from the port is about 6500, of over 2,000,000 tons burden. The entrance to the harbour has been widened to over 320 feet. Its excellent canal and railway facilities have also greatly added to the commercial advantages of the port. The town has extensive manufactories of paper, sulphuric acid, tobacco, cotton goods, starch, lace, oil, machinery, ropes, and salt. There are also some sugar refineries, iron foundries, and several shipbuilding yards. which have constructed some of the best sailing vessels and swiftest steamers belonging to France.

It was feared, after the Germans had captured Amiens in October, 1870, that their next operations would be directed against Havre. The fortifications were therefore put in a thorough state of preparation for defence, and the usual precautions of earthworks, &c., added. General Faidherbe was at the time in command of the northern French forces, which had retreated to the shelter of Cambrai, Arras, Lille, and other fortresses; and in order to draw off the Germans from Havre he collected his army and made a rapid descent upon Amiens, fighting a severe battle at Querrieux, a few miles from the former town. Apprehensions for the second French seaport were thus allayed for a time, and in fact no serious effort was made against it during the war. The most remarkable episode of the war for Havre was the blockade of the port by the French themselves, a fear existing lest it might be captured by the Germans and used as a base of operations or supplies.

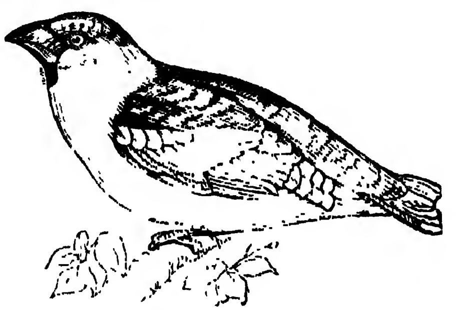
HAWAI'I, formerly called *Owhyhee*, the south-easternmost and the largest of the whole group of the Sandwich Islands, which are sometimes known as the Hawaiian Islands. In form it approaches to a triangle, is nearly 100 miles long from south to north, and about 80 miles wide in the broadest part. The chief town is Hilo. The interior is occupied by a table-land 8000 feet above the sea-level, chiefly covered with lava and ashes, but in some places overgrown with wanti trees, or paper-mulberry trees. The edges of this table-land are distant 20 or 25 miles from the sea. On the table-land are many lofty mountains, of which Mauna Kea attains an elevation of 14,000 feet, and Mauna Loa 13,760 feet; they are all volcanic. The latter has two craters, the lower of which is called Kilauea, and is very remarkable. It is not, like other volcanic craters, a cone, but a depression below the general surface of the slope, of somewhat irregular shape, with almost perpendicular sides. The elevation where this vast pit occurs is 3873 feet above the sea-level. The steep descent to the crater is interrupted by two narrow plains or ledges, the first of which is 715 feet below the upper surface, and the next about 100 feet. The crater contains two lakes, the surfaces of which are 43 feet below the last-mentioned ledge. The smaller lake is nearly of a circular form, and 319 yards across; the larger is 1190 yards long, and in one part about 700 yards wide. These lakes are vast caldrons of lava in a state of furious ebullition, sometimes spouting up to the height of 70 feet. The fiery waves run with a steady current at the rate of nearly $3\frac{1}{4}$ miles per hour southward, enter a wide abyss, and fall into the sea in 19° 12′ N. lat. From 1856 to 1859 it was in a constant state of eruption, offering a sublime but terrifying spectacle. It was also in a state of partial eruption when visited by Miss Bird in 1875, and by Miss Gordon Cumming in 1881. From the edges of the table land the country has a gradual slope to the sea. The higher part of this slope is covered with dense forests, consisting chiefly of several species of acacia, which attain a great size, and of which the canoes of the natives are made. The lower part of the slope, and the strip of land thence to the sea, have a fertile soil and a great variety of productions. The north-east coast is mostly bold and steep, the other coasts are inclined. Byron Bay, on the eastern shore, is a spacious harbour which lies south and north; it is protected from

the north-east wind by a coral reef. Two mournful incidents are connected with Hawaii Island—the death of Captain Cook, in 1779, from an attack of the natives, and of Mr. Douglas, a Scotch botanist, who in 1834 fell into a bullock-trap, and was horribly mutilated by an infuriated captured animal. In 1874 an obelisk monument was erected to the memory of Captain Cook close to the spot on which he met his death.

HAWARDEN (pronounced *Har'den*), a town of Wales in the county of Flint, is situated 6 miles W. of Chester and 187½ miles from London, being 1½ mile from the Queensferry station of the London and North-western Railway. It is chiefly known as having in its vicinity the residence of Mr. W. E. Gladstone. This residence, the modern Hawarden Castle, is built near the ruins of an ancient castle of the time of the Conqueror. The population of the parish in 1881 was 7087.

HAW'FINCH (*Coccothraustes vulgaris*), or Grosbeak, is one of the largest birds of the Finch family (FRINGILLIDÆ), being about 7 inches in length. It is widely distributed, being found throughout Europe, in Asia as far east as Japan, and in Northern Africa. The hawfinch is the only species of the genus Coccothraustes, as the Japanese form, till recently made a distinct species, cannot be separated from it.

The hawfinch has the top of the head, the nape of the neck, the rump, and upper tail-coverts fawn colour; the



Hawfinch (*Coccothraustes vulgaris*).

back of the neck gray, the back chestnut-brown, and the lower surface pale nutmeg-brown; round the base of the bill there is a black line, from which a patch extends on each side to the eye; the throat also presents a black patch; the wings are black, with the larger wing-coverts white, and the fifth and four following primaries exhibit a very peculiar form, being notched at the tip on the inside, and terminated on the outside with elongated and curved barbs, which form a sort of hook. The tail feathers are black at the base and white at the tip, except the two middle ones, which are grayish-brown with white apices. The female is generally like the male, but with the colours much less brilliant.

The young of the year before the moult are very different in their plumage from the adult birds. The throat is yellow; the face, cheeks, and summit of the head dirty yellowish; the lower parts white or whitish; the sides marked with small brown streaks, with which all the feathers are terminated. As the young bird advances in age, some red vinous feathers appear disposed irregularly upon the belly; the upper parts are of a tarnished brown spotted with dirty yellowish; the bill is whitish brown, except at the point, where it is deep brown.

In our island the hawfinch is not often to be seen, probably more on account of its recluse habits than its actual rarity. It was once thought that this bird was only an occasional visitant, but it has been satisfactorily proved that it is not migratory, but remains with us during the whole year, inhabiting dense woods, and invariably perching on the topmost branches of the tallest trees; it builds, however, in dense bushes. Its nest is composed of twigs, intermixed with a larger or smaller quantity of fragments of gray lichen; the latter is never wanting, and sometimes constitutes the greater part of the nest. The materials are loosely put together, and the cavity is lined with fine roots and hair. The eggs are from four to six in number, of a pale olive colour, spotted with black, and streaked with gray. Hard seeds and kernels form the principal food of the hawfinch or grosbeak, but it feeds also on the berries of the hawthorn, whence its name.

HAW'ICK, a town of Scotland, in the county of Roxburgh, situated about 10 miles S.W. from Jedburgh. 53 miles S.S.E. from Edinburgh by the North British Railway, and 346 N.N.W. of London. It is situated on both banks of the Teviot, at the junction of the Slitrig, which flows through the town. The place is well built, and the Teviot is here crossed by several bridges. There are also two bridges, one of which is very ancient, over the Slitrig. Besides the parish church, which was restored in 1880, there are numerous other churches and places of worship, many of them being handsome buildings. The town also contains a town-hall, an exchange, grammar-school, public library, banks, agricultural society, and a school of arts. The houses, being built of stone and slated, give the town a substantial thriving appearance. Hawick was formerly as distinguished for nursery and seed culture as it is now for its woollen manufactures, a department of industry which owes its origin to the command of water power which the Teviot and Slitrig afford, and to the wool-growing district in the midst of which Hawick is situated. The manufacture of the cloths called Tweeds is carried on very extensively, and there are many resident manufacturers and wholesale merchants engaged in it. The town was formerly the chief seat of the hosiery trade in Scotland, but this has somewhat declined. Flannels, plaids, shawls, blankets, and other woollen goods are, however made in large quantities. It has been a burgh of barony from a very early date, but its ancient municipal corporation was reformed by special Act of Parliament in 1861. Since the Scotch Reform Act of 1868 it has remained the head of a parliamentary district of burghs, returning one member, consisting of Hawick, Selkirk, and Galashiels (the two latter in Selkirkshire). The population of Hawick in 1881 was 16,184, and the number of voters averages about 2500. The feudal superiority of the burgh descended to the barons of Buccleuch till 1747, when, all hereditary jurisdiction being abolished by Act of Parliament, the Duke of Buccleuch received £400 in compensation for the regality. Being a border town, and consequently of old exposed to attacks from the English, the houses were anciently built with stone walls and vaulted below, without any door to the street, but having an archway giving access to a courtyard behind, from which alone entrance to the house was obtained. Of these structures a few specimens yet remain. Hawick was burned down in 1418. It suffered severely in 1544, when the whole district of Teviotdale was laid waste by the English. To prevent its occupation by the troops of the Earl of Surrey, in 1570, the inhabitants themselves tore off the thatch from the roofs of the houses, and set fire to it on the streets, by which, with the exception of the Black Tower, now a hotel, the whole town was completely consumed. The inhabitants of Hawick mustered strong at the battle of Flodden, and were there nearly extirpated; but the survivors succeeded in rescuing their standard, which is still carefully preserved.

There is an artificial mound of earth situated at the western extremity of the town, called "the Mote," used in ancient times for meetings both judicial and deliberative. Branxholm Castle, the ancient seat of the Scotts of

Buccleuch, and celebrated in "The Lay of the Last Minstrel," is situated within 2 miles of the town.

HAWK is a name often applied to all the FALCONIDÆ except the eagles. In a restricted sense the word may be applied to the members of the subfamily Accipitrinæ. This subfamily is distinguished by the possession of long legs and short wings; the bill is short, curves directly from the cere, and is never notched. The sexes vary greatly in size. The species are numerous and world-wide in distribution. The important species are noticed under GOSHAWK (Astur) and SPARROW-HAWK (Accipiter).

HAWK MOTHS (Sphingidæ) is a family of lepidopterous insects, known also by the name of the Sphinx Moths. The body is thick and stout; the antennæ are thickened in the middle or towards the end, and terminate acutely. The wings are long and narrow, and traversed by strong nervures. The thorax and abdomen are covered with a thick velvety pile. The habits of some are nocturnal, of others diurnal. The metamorphosis is complete. The caterpillar lives on the leaves of shrubs and trees, and has nearly always a pointed horn on the back of the last segment but one. The name Hawk Moth is due to the swiftness of flight of these moths; the name Sphinx Moth to the peculiar position assumed when at rest by the caterpillars of some. Many hawk moths are found in Britain, and of these the largest and best known is the Death's-head Moth (*Acherontia atropos*). This splendid moth, having a span of wings of about 5 inches, owes its singular name to a pattern in the thorax presenting considerable resemblance to a human skull figured in gray on a black ground. The fore wings are dark brown, with black and yellow markings; the hind wings are buff, with two black bars. The body is broad, and the antennæ short and hooked. The caterpillar is of enormous size, green, with pink stripes on the sides. The death's-head moth has the power of emitting a squeaking sound. It sometimes enters hives and consumes the bees' stores; and its peculiar note, not unlike that of the queen bee, is thought to overawe the workers. This moth is very plentiful in Kent. The Eyed Hawk Moth (*Smerinthus ocellatus*), another British species, owes its name to the presence near the hinder angle of each hind wing of a dark patch inclosing an eye-like spot of a pale bluish colour. The PRIVET MOTH (*Sphinx ligustri*) is so called from its caterpillar feeding on the leaves of the privet. The Elephant Hawk Moth (*Chærocampa elpenor*) owes both its common English name and its generic name (hog-caterpillar) to the tapering and retractile character of the front segments. Another English species, somewhat rarer, is the Small Elephant Hawk Moth (*Chærocampa porcellus*). The HUMMING-BIRD MOTH (*Macroglossa stellatarum*), a tolerably common British species, is the representative of a group of hawk moths that resemble humming-birds so closely on the wing as to be constantly mistaken for them.

HAWK'ING. See FALCONRY.

HAW'KINS, SIR JOHN, a distinguished seaman of the reign of Elizabeth, was born in Plymouth in 1520. His youth was spent in trading to Spain, Portugal, and the Canaries. With the assistance of some merchants he fitted out a small squadron in 1562, and obtained, partly by purchase and partly by force, a cargo of 300 negroes, whom he carried to Hispaniola, and there sold. This, we believe, was the first adventure of Englishmen in that inhuman traffic. He made a second voyage in 1564, and a third in 1567; the latter turned out unfortunately. He was attacked by the Spanish authorities in the port of San Juan de Ulloa, and saved but two ships of his squadron, with which, after suffering great hardships, he returned to England in January, 1568. In 1588 he served as rear-admiral against the Spanish ARMADA, and was rewarded with the honour of knighthood. Being sent with Frobisher in 1590 to intercept the Plate fleet and harass the trade of Spain, he failed in the first object, but succeeded in the second. In 1595 he was appointed, jointly with Drake, to command a more important expedition against the Spanish settlements in the West Indies. This enterprise proved fatal to both these hitherto successful commanders. [See DRAKE.] Hawkins died 21st November, 1595. He sat in Parliament for Plymouth, and founded an hospital at Chatham for poor and sick seamen.

HAW'KINS, SIR JOHN, a biographer of Johnson and an historian of music, was born on the 30th March, 1719. He was articled to an attorney, and remained in the law till 1759, when he retired with a competent fortune. While in the law he cultivated the study of music, and associated with Dr. Johnson and other literary men. Between 1759 and 1772 he served as a Middlesex magistrate, and it was for his efficiency in this office that he was knighted.

Sir John Hawkins then set seriously about finishing a work which gained European reputation—his "History of Music," which appeared in 1776, in five quarto volumes, under the title of "A General History of the Science and Practice of Music." Sir John Hawkins' entire history appeared in the same year as the first volume of Dr. Burney's history; and the readable style of the latter at once unduly elevated it above the really more useful though more difficult book of Hawkins in the popular estimation. Hawkins was republished in 1853; Burney is not worth the labour. He afterwards issued an edition of Walton's "Angler" and a "Life of Dr. Johnson." He purchased and presented to the British Museum the valuable musical library of Dr. Pepusch. He died in 1789, leaving behind him a high character both for moral and intellectual qualities.

HAWK'WOOD, SIR JOHN, a famous English *condottiere* or *free lance* of the middle ages, was born about 1324 at Hedingham, Essex, his father being a tanner. He was knighted at Poitiers. At the peace of Bretigny (1360) he joined the free lances ravaging the south of France, and eventually proceeded to Italian ground. He was at the time captain of his band, and took service for pay under first one republic and then the other, fighting fairly through each engagement, however, though his next campaign might be under the banners of his former foes, if they had outbidden those he was serving. He rendered some services to the pope, and was rewarded with lands near Ravenna, where he settled. His usual Italian name is *Acuto*, an endeavour after *Hawkwood* which is sufficiently funny, but which is beaten by the other name he bears, a translation of his patronymic into *Falcone di Bosco*. In 1380 he definitely assumed command of the armies of Florence, having shown himself the most consummate captain of his time. His greatest feat was a remarkable retreat from Milan in 1391, when he brought his army out of apparently insurmountable dangers. He won twenty-two pitched battles and was only once defeated. He died in 1394, and was buried with great splendour by the republic of Florence.

HAW'SER, HAWSE. A hawser is a large kind of rope differing from a cable as consisting of only three strands, whereas a cable has no less than nine. A hawser may of course be as thick as a cable, its thickness depending upon the amount of yarns put into each strand. A cable may be regarded as composed of three thin hawsers.

The word hawser means a cable used at the hawse; and the hawse is the sea space immediately in front of a ship at anchor by two cables at the bows, so that it is sometimes complained of another ship that "she anchored in our hawse," as running a danger of fouling the anchor-cables, &c. The word comes from ***hals*** (Icelandic, Danish, and German for neck), meaning ***neck*** or bow of a ship. Halse-holes, or ***hawse-holes***, are holes in the bow, and halsers or ***hawsers*** ropes passing through such holes.

HAW'THORN. See CRATÆGUS.

HAW'THORNE, NATHANIEL, a distinguished American author, was born at Salem, Massachusetts, 4th July, 1804. He was educated at Bowdoin College, Brunswick, Maine, where he graduated in 1825, having for classmates Henry W. Longfellow, John S. C. Abbot, and Franklin Pierce. It had been his desire from his boyhood to become an author, and after leaving college he commenced his literary career by writing for *The Token*, a holiday annual, and in 1837 a collection of his writings was published under the title of "Twice-told Tales." It was favourably reviewed by his friend, the poet Longfellow, but met with only moderate success. In 1841 he published a collection of stories for children under the title of "Grandfather's Chair," and the same year he joined the industrial community of Brook Farm, staying there twelve months. In 1843 he married Miss Sophia Peabody, and took up his residence in an old parsonage at Concord, Massachusetts, which had formerly been the abode of Emerson. In 1842 he published a second portion of "Grandfather's Chair," in 1845 a second part of "Twice-told Tales," and in 1846 a collection of his writings under the title suggested by his dwelling-place of "Mosses from an Old Manse." In the same year he was appointed surveyor of customs at Salem, where he remained until the change of administration in 1850. This year was marked by the publication of his powerful romance, "The Scarlet Letter," and in 1851 there appeared "The House with the Seven Gables," works which caused his genius to be fully recognized both in America and England. "The Wonderbook for Boys and Girls" and "True Stories from History" followed in 1851. The "Blithedale Romance"—a story which, though a fiction, is based upon the fortunes of the Brook Farm community, and contains much of an autobiographical character—and "The Snow Image" appeared in 1852. This year he also published a life of Franklin Pierce, his old college friend, who was then a candidate for the presidency. In 1853, when Pierce was elected, Hawthorne received the appointment of consul at Liverpool, and he remained for the next seven years in Europe. His "Tanglewood Tales" were published in 1853, and "Transformation" in 1860. He returned to America in 1860, and in 1863 published his work entitled "Our Old Home," in two volumes, which contains admirable criticism upon English life and society from an American point of view. He died suddenly at Plymouth in Massachusetts, 19th May, 1864, leaving an unfinished work entitled "Septimius Felton," which was published after his death in 1872. In his works Hawthorne displays a deep knowledge of human nature, a high tone of morality, and above all a fantastic and subtle imagination. They are all written in a style of exquisite beauty, ease, and grace, and while he is perhaps the most original of the American writers of fiction, he must also be ranked as one of the finest prose writers of the English language. His name was actually Hathorne; he inserted the *w* when he began to write for the public.

HAY is the name given to the stems and leaves of numerous grasses and allied plants dried for the purpose of feeding cattle. In the pastoral districts of England the product of a large surface of natural grass land, probably about 4,000,000 acres, is thus used, an additional 2,500,000 acres being devoted to clover and artificial grasses. In Scotland comparatively little of the meadow grass is converted into hay, the crops there consisting chiefly of clover and rye grass. The plan of making hay varies in different parts, but in England the following is usually adopted on the best farms. The grass, after being cut with the scythe or mowing machine, is shaken and spread out to dry by means of forks or an implement called a tedding machine; towards evening it is raked up into rows, or if rain is threatened into small heaps or cocks. This is repeated for a second or a third day when, if the weather be favourable, the hay will be ready for the rick. In Scotland the hay after being dried is packed first in small cocks, each of from 1 to 2 cwts., ten or more of these are then united to form what are called tramp-ricks, and when it has become thoroughly dry it is stored away in large stacks in the rickyard. It is only when bright sunshine prevails that hay can properly be made, and the time required for the purpose varies according to the weather as well as to the bulk of the crop and the quality of the land. The best time for gathering hay is when the grass is in bloom, as it then contains the largest amount of nutritive qualities. When left till the seed ripens the stalks become hard and woody, and much of the sugar, gum, and gluten are lost. It has been calculated that with several of the more important grasses the food value of the hay gathered when they are in flower is three times as great as of that gathered when they have run to seed. Great care is required in the making and packing of hay, for if too much of the natural moisture of the grass is retained the hay becomes overheated, turns brown or black, acquires unwholesome properties, and sometimes takes fire. If put together when damp from rain or dew it speedily moulds and spoils. June is the usual month for haymaking in England and July in Scotland. The crop usually averages from 1 to 2 tons per acre.

The hay harvest forms a very important item in the year's agricultural returns, and so much is lost or spoiled in wet seasons that various attempts have been devised for drying grass by means of artificial heat, or of preserving it when it is stored in a damp state. Of the former, one of the most successful is that designed by Mr. W. A. Gibbs, a practical farmer of Gillwell Park, Chingford, Essex, who introduced his system in 1875 after fifteen years of practical experiments. The apparatus is in the following form:—A portable stove, constructed of plate iron, is surmounted by a fan, which is driven by a belt from a three-horsepower portable steam-engine; the fan draws all the heated air and gases from the coke fire, together with a volume of warmed air, which passes through a chamber surrounding the inner chamber of the stove, and blows the hot current, at a temperature of 400° Fahr. or more, into the drier. This resembles in general shape a straw elevator, consisting of a sheet-iron trough 6 feet in breadth, 20 feet long if mounted on wheels as a portable carriage, or from 40 to 50 feet long if a fixture. The trough is raised at one end at a low angle, so that hay fed in at the upper end furthest from the stove shall slowly travel to the lower end near the stove—this being assisted by a slow reciprocating motion given to the bottom of the trough. A ridge of triangular section running along the middle of the trough divides it into two almost semicircular channels, so that the hay passes down in two streams; the hot air issues through two slit apertures, one on each side of the base of the middle ridge, and extending the entire length of the machine; and the hay is kept continually stirred and shaken up over the hot blast by a number of small iron stirrers cleverly contrived to imitate the action of forks worked by hand. A small portable steam-engine keeps the apparatus going, so that it can be taken from field to field, or be fixed permanently near the hay sheds. By one of these machines 2 tons of grass from a water meadow has been converted into finished aromatic hay of a good colour in less than one hour, and it is claimed on behalf of the apparatus that the blast of hot air blows out dust and must, and serves to destroy the germs of microscopic life with which it is laden. The process is not intended to supersede the sun and winds, but to aid when occasion requires in the final and most important stage of hay-drying.

Of the methods of wet storage one has already been described under ENSILAGE, and another, introduced by Mr. R. Nelson of Halewood, near Liverpool, is carried out as follows:—When the grass is mown it may lie in swathe a couple of days, with a single turn over on the first day,

or it may be tedded over the ground soon after cutting. It is then gathered into a large stack, in the raised earth base or staddle of which is laid an air-tight drain, which may be of earthenware, wood, or iron, of several inches diameter, joined with cement; and this tube or air passage communicates between an aperture in the centre of the staddle and a blowing fan situated at a short distance from the stack, in a building or otherwise. When the rick is 20 feet in width, the aperture will be 10 feet from each side; and in case of a long rick more than one aperture is provided, the tube being continued along the middle of the staddle for the purpose. Each aperture is fitted with a sliding lid, like the door of a kitchen-range damper, and can be opened or closed by a rod extending outside the bottom of the rick. In stacking the hay a vertical air-shaft or chimney is formed over each aperture, by the common method of drawing up a sack of straw or a round chaff-basket as the building of the rick proceeds; but these ventilating flues are carried up to only half the height of the stack. The object of this arrangement is that when the exhaust fan is set in motion, drawing air from the underground pipe and rarefying the air in the chimney, the replacement of that air can come only by currents penetrating the rick from the outside walls and roof, and gradually converging into the chimney in the centre. By this suction of hot air and moisture out of the middle of the mass, cold air is induced to enter the stack at all points and to seek the central flue, bearing with it the excess of heat and the moisture, and cooling the whole substance of the rick. No great force is required for this, and one horse working a fan by means of an ordinary chaff-cutter horse-gear and intermediate speed-gear, will do well; and two men turning a corn-dressing machine fan arranged in connection with the air-tube have been able to accomplish all that was wanted for cooling a stack. With a gentle exhaust the atmospheric air is caused to permeate every part of the rick in ample quantity for keeping down the temperature of the fermenting grass. In order that the temperature may be readily ascertained when the stack is built, wooden tubes are laid at various heights, of bore large enough to admit a thermometer to be introduced on a lath, these tubes reaching horizontally from the outside to the centre; and thus the heat of all portions of the stack can be examined. A temperature of 100° is considered the *maximum* at which it is advisable to let the fermentation work, the fan being set in operation at any heat approaching this. Of the different systems, that of converting the hay into ensilage seems to be regarded with the most favour, but the importance of the subject is such that it is to be hoped that all methods will be thoroughly tested by experiments on an extended scale. If the farmer could be made only partially independent of the weather in this matter an enormous advantage would be secured.

HAYBOTE, an ancient agricultural term to signify the right of a tenant, or other person, to take bushes, wood, &c., for repairing fences, gates, and such like.

HAY FEVER or **SUMMER CATARRH** are names given to a peculiar affection of the mucous membrane of the nostrils, eyes, and the air passages of the throat and chest, producing either the symptoms of a very severe cold in the head or an asthmatic oppression of the breathing, or both. Usually it is attended by headache, with suffusion of the eyes, irritation of the nose and the back of the throat, sneezing, and a dry and troublesome cough. Where the affection assumes an asthmatic form the attacks may last for two or three hours at a time, the shortness of breath being so extreme as to induce a fear of impending suffocation. No danger to life is to be apprehended as the result of attacks of this affection, and there is but little risk of structural injury, except in cases where the asthmatic symptoms are unusually prolonged and severe; but persons who have once suffered invariably have a return of the complaint if exposed, however slightly, to the exciting cause.

It is a curious circumstance that this affection is almost exclusively confined to Englishmen and Americans, and among them to such persons as are possessed of education and some degree of social position. It is found that persons of nervous temperament are most liable to its attacks, though women, in spite of their sensitive nervous organization, are much less subject to it than men, and it has been clearly proved a susceptibility to this affection runs in families and is of an hereditary character.

The disease was recognized and described early in the present century, and was probably in existence long before, but its causes were not fully understood until a comparatively recent period. The researches, however, of Dr. Blackley of Manchester, himself a sufferer from this affection, have proved that it arises from the breathing of air charged with the pollen of flowers and grasses. Dr. Blackley proved in his own case, and in those of other susceptible persons, that the inhalation of pollen invariably produced the proper symptoms of hay fever, that there was a direct relation between the amount of pollen in the air and the intensity of the symptoms, and that none of the other causes which had been suspected—such as heat, light, dust, odours, or ozone—could of themselves produce the complaint. He further showed, by a series of most careful observations, that the pollen of rye is more potent than that of some of the grasses; that the pollen of wheat, oats, and barley is also an active irritant; and that during the season of hay fever in England 95 per cent. of the pollen floating in the atmosphere belongs to the Gramineceæ, the time for the flowering of which is between the end of May and the latter part of July.

In some persons, however, an attack closely resembling summer catarrh is produced by the inhalation of any dust of an irritating character, while analogous disorders prevail in some parts of the United States which are caused by the scent of roses or of peaches, and are known there as rose fever, rose catarrh, and peach cold.

The causes of this complaint being thus indicated, it will be obvious that the only way for those who are liable to it to escape attacks is to avoid breathing air that is laden with the irritating pollen. For those whose circumstances will allow of it, a visit to a suitable seaside resort will often remove the symptoms as if by magic, and a cruise in a yacht, when care is taken that no dry hay is brought on board, is almost a specific for hay fever. Of course the effect of a seaside visit will depend upon the direction of the wind, for if it blows over cultivated land it will bring the pollen with it; but there are several places in England which from their situation are not liable to this, and which have special reputations as places of resort for those liable to this affection.

Next to a visit to the sea the centre of a large town offers the most advantages, and it is a good plan to keep indoors during the middle of the day. Dr. Morell Mackenzie, in his valuable work on this subject, recommends plugging the nostrils with cotton-wool and wearing spectacles with large frames fitting accurately round the orbit. If this plan be adopted, the plugs should be sufficiently loose to allow of respiration taking place through them, so that the mouth may be kept closed, and they are rendered more effectual by being moistened with carbolated oil. Dr. Blackley has invented a nasal respirator, which can be worn with comfort and is scarcely noticeable from a short distance. Dr. Mackenzie also suggests that a fine gauze veil should be worn, fastened round the hat and attached below to an iron ring resting on the shoulders.

The nervous irritability that induces an attack may be lessened by careful attention to the general health, in such matters as diet, exercise, early hours, cold bathing, the avoidance of over-fatigue, and anything of a character to

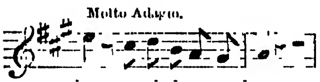
depress the system, and by the use of suitable tonic medicines. Of the latter, nux vomica, quinine, arsenic, and the valerianate of zinc have all been used with advantage. Where the disease has become established in the form of catarrh, a continuation of quinine, morphia, and camphor forms a powerful remedy for affording relief, and in many cases creosote inhalations have proved of service. Where it assumes the form of asthma the distressing symptoms may be alleviated by the inhalation of the fumes of nitric paper, stramonium, or of tobacco. The latter has been strongly recommended both as a preventive of the asthma and as a means of cutting short an attack, but it will be of slight benefit to an habitual smoker, so that a person liable to this affection should never smoke tobacco except for his malady.

HAYDN, FRANCIS JOSEPH (*Franz Josef*, usually called *Joseph Haydn* simply), the renowned composer, was born at Rohrau, a village on the borders of Austria and Hungary, 31st March, 1732. His baptismal register of the day following led to the mistake, in which even he concurred, that this date, 1st April, was his birthday; he died at Gumpendorf, a suburb of Vienna, 31st May, 1809. His father, Matthias, was a cartwright by trade, but sufficiently a musician by nature to accompany his wife's singing by ear on the harp. Haydn's mother, Ann Marie, had been cook to the chief family in the village. On Sundays and saint-days this worthy pair used to divert themselves with music, and it was the delight of little Joseph, when he was five years old, to take part in their performances by pretending to play on a sham fiddle. A cousin of his father, named Frankh, the schoolmaster of Hamburg, witnessed some of these family concerts, and perceived the boy's musical aptitude, from the certainty with which he beat time and the correct intonation with which he joined in the song. He took the boy home with him, and not only instructed him in reading and writing and the rudiments of Latin, but taught him to play on a real violin and several other instruments. In 1740 Geo. Reutter, the kapellmeister of St. Stephen's at Vienna, made an excursion to seek for voices to recruit his choir; coming to Hamburg he heard young Haydn, was pleased with his precocious proficiency, and gladly engaged him. Besides singing in the service in public, the choir had to practise two hours daily. Beyond the fulfilment of these duties, Haydn had no occupation; but, as it seems, with no assistance from his master beyond two lessons in all, he applied himself assiduously to the general study of music. When thirteen years old, being wholly untaught in the rules of composition, he wrote a mass, which, when he showed it to Reutter, that functionary treated with the ridicule it probably deserved. Stimulated rather than discouraged by this mockery, he spent the few florins which he possessed in buying musical treatises, which he studied as well as he could unassisted. In 1748 his voice broke, and his brother Michael supplanted him in the principal parts. Reutter proposed to preserve his soprano voice by mutilation, a practice formerly so common and even now occasionally practised in Italy, but he indignantly refused. Reutter sought therefore to get rid of him. Accounts differ as to the date and the cause of his quitting the cathedral. The likeliest appears to be that in 1751 he played the practical joke on another member of the choir of cutting off the tail of his wig; and the subject of this trick complained of it so loudly that poor Haydn was expelled at a moment's notice, and thus found himself suddenly thrown out of board and lodging and occupation, alone in the street, on a winter's night. Keller, a wigmaker, who rented a single room and a loft, invited Haydn to sleep in the latter, and offered him a place at his table. In this mean abode, with neither fireplace nor window, the young musician had the luxury of a harpsichord; and, when the weather was warm enough for him to be out of bed, he pursued his darling study with more earnestness than ever. The first six sonatas of Emmanuel Bach now engaged his attention; and, while he practised them to exercise his fingers, he gleaned from them, as he used afterwards to declare, the principles of musical construction, for the development of which the art owes more to his subsequent exertions than to the labours of any other composer. He obtained some pupils, and wrote for their use six trios and some other instrumental pieces, which appear to have been his first completed productions. In this year, 1751, he brought out his first opera, "Der Krumme Teufel," for which he was paid twenty-four ducats, having been engaged to write it by the manager of one of the little theatres, who had become acquainted with his ability by hearing him with others perform in the street a serenade of his own composition. Haydn's means of subsistence were eked out by church engagements to play the violin and the organ. Later he lodged in the garret of the house in whose better rooms was staying Metastasio, whose niece was his pupil; and he seems to have derived great advantages from his intercourse with the poet, learning from him to regard art in its highest sense, and receiving thus the noblest stimulus to his ambition. By him he was introduced to the mistress of Count Corner, the Venetian ambassador. The lady's fondness for singing had induced her admirer to bring the famous teacher Porpora in his suite as her instructor, and Haydn was engaged to accompany her in her practice. It was mainly with the purpose of witnessing Porpora's lessons that he undertook this duty; and he was happy to discharge any, the most menial, offices for the old Italian during the three months he spent with the lady and her teacher at Manensdorf, for the sake of ingratiating himself in his esteem, and so obtaining the benefit of his instructions. With the same object of gaining information in his art, he attached himself for some time also to the composers Gluck and Wagenseil; but there is no reason to believe that he ever received an actual lesson from either them or Porpora. In 1755 he wrote his first violin quartet (one in B flat), for performance at the house of an amateur. The Countess Thun, who had met with some of Haydn's music, sought him out with some difficulty, and, discovering his indigent condition, made him a present of twenty-five ducats, and greatly aided him by her countenance and encouragement. In 1758 he was engaged as second kapellmeister by Count Morzin, in whose service he wrote his first symphony (one in D), which was played at one of the count's private concerts in 1759, when Prince Anton Esterhazy was present; and this illustrious dilettante was so charmed with the work, that he asked the count to relinquish its composer to him. Haydn was accidentally absent from this performance; the transfer of his engagement was thus not ratified at the time, and the matter was accordingly forgotten by the prince. He would have lost this great advance in his fortunes, but for the kindly efforts of Friedberg, the leader of the prince's band, who advised him to compose another symphony, and caused this (one in C, op. 1, No. 5) to be played on his patron's birthday, 19th March, 1760. Esterhazy, as much pleased with this composition as he had been with the former, immediately gave Haydn the appointment of second kapellmeister, which he held until the death of Werner left the principal office open to him. It was now that, having secured a permanent competency, he married Maria Anna, the elder daughter of his early benefactor, Keller. This appears to have been an alliance of gratitude rather than of love. Haydn is said to have been attached to the poor wigmaker's younger daughter; she, in the interim, had entered a convent, and he could only fulfil a promise to become his old friend's son-in-law by taking her sister. His wife is said to have been a prude and a bigot, and utterly careless of art; be this as it may, they had no happiness with each other, and soon

agreed to a separation. He, however, allowed her an adequate maintenance until her death in 1800. Haydn consoled himself in the society of a lady named Boselli, a singer engaged like himself by Prince Esterhazy, and to whom he was moderately faithful.

Prince Anton died in 1761, and his brother Nicolas (the "Magnificent") renewed the composer's engagement. Haydn was now in a position, the most advantageous for an artist, of independence of the world, and with no cares but for the development of his powers. For nine months of the year he lived at Eisenstadt, the residence of his patron; and he spent the other three months at Vienna during the prince's visit to that capital. In 1766 a vast palace was built at Esterhaz on the Neusiedler See, and the whole establishment was then carried thither for the greater part of every year. "I was *forced* to be original," says Haydn, for there was no one to copy. Sometimes such long absence from their families was irksome, and Haydn on one occasion wrote the "*Farewell* Symphony" as a hint. In the last movement the performers leave the orchestra one by one as if going home. When only one fiddler was left the prince took the hint, and said, "Well, we had better go too!" There was a theatre in the palace, at which twice a week an opera was performed; and for this establishment Haydn wrote the majority of his German, and probably some of his Italian operas. His duty was also to direct an orchestral concert every afternoon, and to furnish new compositions for these performances. Here, then, was the field for the cultivation of that extraordinary genius to which modern instrumental music is indebted, if not for its origination, certainly for the maturing of the art of form, which distinguishes all that has been written since from all that was produced before the time of Haydn. The fame of the composer soon extended all over Europe; but his first engagement out of his own country was to write six symphonies in 1784 for a series of concerts given in the Loge-Olympique at Paris. In 1785 he produced the succession of instrumental movements called the "Seven Last Words of the Redeemer," for the solemn celebration of the Passion at Cadiz, where this ceremony consisted in the bishop's enunciation of the words of the divine agony, after each of which one of these deeply pathetic pieces was performed. Michael Haydn added vocal parts with appropriate words to this work, in which form it is classed as one of the composer's oratorios; Haydn himself also arranged it for string instruments, and in this shape it is counted among his violin quartets. It was in 1785 that Haydn received the touching tribute of the dedication of the famous six quartets of Mozart, on which occasion he said to Mozart's father, "I declare to you on my honour that I consider your son the greatest composer that ever lived," so little room for jealousy was there in the mind of this large-hearted man. In 1790 the prince his patron died, and the musical establishment over which Haydn presided was then broken up, but the salary continued. The thirty years spent by this great master in the service of the Esterhazy family may seem barren of incident; but their eminent importance to the progress of music is proved by the vast number of works he wrote during the undisturbed tranquillity of that period, the production of each one of which was an event in the history of the art, since each one was a signal advance towards the maturity, not only of Haydn's genius, but of the principles it was his great task to develop. A new field was now opened for the labours of the master, and this was the one in which he has left the most imperishable imprints of his power. Salomon the violinist, resident in London, formed the design of engaging Haydn and Mozart to compose for the professional concerts of which he was the director, and to come hither to conduct their works; he went accordingly to Vienna to propose the matter to his immortal countrymen, and it was settled between them that Haydn should be the first to come, but that Mozart should succeed him in the following year. In the last days of 1790 Haydn set out for London; here he worked, during the remainder of the year, at the first six of the symphonies he composed for Salomon, and on the 4th of February following the series of concerts was inaugurated, by the production of the first of these great works, in which the world acknowledges the masterpieces of the author. Haydn's success here was immense, and he returned to Vienna with as much profit as glory. He took now the house at Gumpendorf, which was his residence for the rest of his life, and resumed the systematic course of daily composition which he had pursued during his long abode at Eisenstadt. At this time Beethoven became his pupil; but there appears to have been somewhat imperfect sympathy between the young giant of instrumental music and the founder of the school in which he was to win his immortality, though each thoroughly respected and admired the other. The death of Mozart before the production of the first of Haydn's symphonies in London prevented the completion of Salomon's design; and the great sensation Haydn had created here induced his friend to offer him a second engagement. He came accordingly in the spring of 1794, and spent a year and a half in London. During this time he wrote and brought out the latter six of the twelve Salomon symphonies, and he composed eight pieces of an opera called "Orfeo" for performance at the King's Theatre; but its production being delayed, he left the country without completing it. Here also he wrote the well-known English canzonets (one of which, "My mother bids me bind my hair," is among the loveliest and the most favourite of all English songs), and the Italian cantata "Ariadne a Naxos," which last he published himself at his lodging in Great Pulteney Street. He received here the greatest honours from all ranks and all classes; the king and the Prince of Wales paid him marked attention, the latter playing the violoncello along with him, &c.; the public applauded him with enthusiasm, and the University of Oxford conferred on him the honorary degree of doctor of music, while he took away with him such a sum as secured his independence for the remainder of his life. He was present at the Handel commemoration of 1791 at Westminster Abbey, one of several repetitions of the centenary performance of 1784; and on hearing the Hallelujah Chorus from so splendid an orchestra and choir, and amid the surroundings of the magnificent church, he burst into tears and wept uncontrollably, exclaiming, "He is the master of us all." In 1793 and 1795, on subsequent visits, he attended every performance of Handel's oratorios and other works most eagerly. He loved England and the English, and worked hard to learn somewhat of our tongue. The Baron van Swieten, a Viennese amateur—at whose instigation it was that Mozart wrote his additional instrumentation of Handel's "Messiah"—entertained the fanciful conceit that the imitation of visible forms and motions was within the province of music. In pursuance of this idea he planned the scheme of the oratorio of the "Creation," and proposed the composition of the work to Haydn, who eagerly entered into his views. Van Swieten compiled the text of this work, interpolating matter of his own between the scriptural passages he selected, and writing the whole of the third part. Haydn entered upon his task with profound earnestness, laboured at it with feelings of the deepest devotion, and spent a greater time upon it than he had ever given to the same amount of composition, saying that he meant the work to live long, and must not therefore hasten its production. Accounts vary as to when he began to write this oratorio; the most natural seems to be that it was not till 1797, but he doubtless gave long preconsideration to its plan. It was completed in April, 1798. Its first performance was at the Schwarzenberg Palace in

Vienna, 19th March, 1799, and its success exceeded that of any musical work that had ever been produced. In England there was a rivalry between Salomon and Ashley (the director of the oratorio performances at Covent Garden Theatre) as to who should first introduce the "Creation" to the public, and Ashley outwitted his competitor by the aid of a king's messenger—an official who then had more rapid means of transit than any other traveller—who privately brought him a copy of the score. This arrived on a Saturday night, and the work, being copied and studied in the interim, was performed on the Friday following, 23rd March, 1800. The "Seasons" was another work in which Haydn had Van Swieten for a coadjutor. The text of this secular oratorio is taken from Thomson's poem, with sundry insertions. It was first played, 24th April, 1801. Its success, though great, was not equal to that of the "Creation," nor has it ever been so popular as this work; but just criticism cannot pronounce it of less musical merit. The powers of the veteran now began to fail him ("The 'Seasons' gave me the finishing stroke," he used to say), and he produced with a difficulty unknown to him before; the weakness from which he suffered was aggravated by his position at the pianoforte, and he was compelled to refrain from the favourite pursuit of his whole life. The quartets Nos. 82 and 83 were written in the course of 1802; after which he spent nearly a year over quartet No. 84. Of this he completed but two movements, and then being forced to desist, he wrote the following pathetic musical phrase, and so closed his artistic career:—



He sent a copy of this very remarkable passage to each of his friends as a visiting card, and thus announced, as no other creative artist has ever done, that he voluntarily retired from a field wherein his course had been one of unchequered honour, and resolved to produce no more. Haydn was drawn from his subsequent seclusion to attend a performance that was given, 27th March, 1808, of an Italian version of the "Creation," translated by his friend and biographer, Carpani. On this occasion all the most distinguished for talent or birth in Vienna were present; the venerable master was wheeled into the front of the dense assembly, thronged to pay him homage, and Princess Esterhazy took her place beside him. Salieri, who was to direct the orchestra, came first to receive the composer's instructions; the performance began—it was interrupted by a murmur of universal admiration at the passage which presents the creation of light—and the author, rising to his feet, and pointing to heaven, exclaimed, "It comes from thence!" Exhausted by the excitement and the exertion, he was obliged to be borne away at the end of the first part of the oratorio, but stopping his chair at the door of the hall, he lifted his hand as if blessing the performers and the audience, the sharers and the donors of his successes. Among the celebrated people who reverently pressed forward to greet his departure was Beethoven, who repeatedly kissed his hands and forehead. He never left his house again. On the 10th of May, 1809, the French commenced the bombardment of Vienna, and though Napoleon in a very noble way placed a guard to protect the dwelling of Haydn, some shells burst so near it that the terrified domestics deemed it necessary to bear him to a place of more security. He stayed them, however, demanding, as though inspired with assurance of divine protection, "Where Haydn is, what is there to fear?" His strength failed him under this trying excitement, and he was carried to his bed never thence to rise. On the 26th of the month he broke, as if by a preternatural effort, from a long torpor and sang thrice, with clear and emphatic voice, his own hymn, already then, as it is still, the Austrian national anthem, "God Preserve the Emperor." This act of devoted loyalty overpowered him, and he sank senseless; five days later he breathed his last. The cause of this superb hymn of Haydn's was the delight he took in the loyalty of the English, and their mode of expressing it musically by "God Save the King."

The remarkable career of Haydn furnishes a grand proof that the inborn power to accomplish great works finds its own means to achieve them. Two lessons from Reutter were all the instruction in composition he ever received, and yet he fixed the form of modern music in its greatest shapes. Who then shall say that such or such a man might have become great had his genius been duly cultivated? The prodigious amount of Haydn's compositions is scarcely credible; the number (eighty-four) of his quartets has been named; there are 118 published symphonies, and twenty-two are mentioned that are unprinted; he wrote more than as many pieces of the same extent for the baryton, an instrument now obsolete, on which Prince Nicolas used to play in concert with his orchestra; his other instrumental works are almost countless; his oratorios have been enumerated; nineteen of his masses are published, as well as his "Stabat Mater" and several other pieces of church music (but it is unknown how much of his labours in this department of the art is hidden from us in MS.); and finally, he produced eight German and fifteen Italian operas, besides some smaller dramatic pieces and a large number of detached vocal compositions. His works, regarded as a successive series, constitute a remarkable illustration of the progress of modern instrumental music, the almost childish infancy of which is to be observed in his first quartets, and its most vigorous manhood in his last compositions for the chamber and the concert room. It must be remembered, however, while we make due acknowledgment of his everlasting services to music, first, that the art of design which he matured, and the constructive forms of which his works have furnished models to all after-writers, were anticipated in essence by Bach, for instance; secondly, that he lived both before and after Mozart, and the immense discrepancy between his first productions and his latest shows how vastly much he gained from his experience of the workings of this wonderful genius; nay, further, that he knew the first thirty publications of Beethoven, and wrote subsequently to this knowledge. There has, perhaps, never been so great an artist who was so little of a poet as Haydn. This is proved by his acceptance of the texts of the "Creation" and the "Seasons" as subjects for musical treatment, and his rendering of many portions of them. A great humorist he was, or he would never have written his "Farewell Symphony," in which each player has successively to leave the orchestra until one remains alone; nor his "Toy Symphony," in which all the instruments of the nursery are brought into requirement; and this quality of humour constantly evinces itself throughout his works, even where its exercise is less positively defined. The epithet given him by universal consent is "genial," and the familiar pet name which in his own country he bears, and was known by even in his lifetime, corroborates the English view of him—to the Germans he is "Papa Haydn." His highest artistic trait was his sincere religious feeling; this was equally distinct from the ostentatious formularity of the Italian and the severe simplicity of that of the German Church; it was an ample sense of the beauty of all things, and a conviction that the Author of this beauty was the source of all happiness. Mozart's Requiem was sung over Haydn's grave, which was outside the French lines. When Prince Esterhazy had him reburied in Eisenstadt in 1820, the skull was found missing. It was stolen, but has since been traced.

There are many works about Haydn, but they are all

now quite set aside in favour of the truly magnificent work by Pohl, "Josef Haydn," two volumes of which have already appeared (in 1878 and 1882). The material was begun to be amassed by the famous Jahn, who had performed a like task for Mozart, and at Jahn's death this was given over to Pohl.

HAYDN, JOHANN MICHAEL (usually called simply *Michael Haydn*), a musician, brother of the illustrious Joseph, was also born at Rohrau on either the 11th or 14th of September, 1737; he died at Salzburg, 10th August, 1806. Like his brother he had his first musical impulses awakened by the singing and harp-playing of his mother and father, and sang as a boy in the choir at Vienna. In 1763 he was appointed music director to the Bishop of Groswardein; in 1768 he passed to the Archbishop of Salzburg; and in 1801, when on a visit to Vienna, being introduced to Prince Esterhazy, this nobleman made him his kapellmeister, but with permission to reside at Salzburg in fulfilment of the offices he still held there. His name as a composer is so greatly eclipsed by that of his brother, that the world scarcely does justice to his merit. One symphony of his, "Die Schlittenfahrt" (The Sledge journey), has even been published as Joseph's, and great ambiguity has in like manner been thrown over some other of his veritable productions. His work on the "Seven Last Words" matches perfectly with his brother's. His ecclesiastical music is also esteemed by intelligent critics as of a very high order; among these ranks his brother Joseph himself, who always declared Michael's church work was better than his own. A jubilee mass, an exquisite Lauda Sion, a Salve Regina, and Salve Redemptor are admirable specimens. Weber, Woelfl, Reicha, and Neukomm were among his pupils, and Mozart, during his Salzburg career, was his close friend and admirer. Once when Michael was ill, and the archbishop threatened to stop his salary if he did not finish some duets he was writing, Mozart finished them for him.

HAY'DON, BENJAMIN ROBERT, an English historical painter of great powers and ability, but more remarkable for the vicissitudes of his life than distinguished for the excellence of his works. He was the son of a bookseller at Plymouth, where he was born 25rd January, 1786, and he was educated at Plympton grammar-school. He adopted the profession of a painter contrary to the wishes of his father, who nevertheless allowed his son to visit London and enter as a student in the Royal Academy. His instructors and advisers were Fuseli, Northcote, and Opie. In 1807 he exhibited a picture of "The Flight into Egypt," which procured the painter a commission from Lord Mulgrave for his celebrated picture of "The Murder of Dentatus," the immediate cause of nearly all the troubles of Haydon's future life, from the dissatisfaction which he felt at the way it was hung in the academy exhibition of 1809. Though many thought the picture well enough hung, the painter took such a different view of the matter, that he considered it a sufficient cause for a quarrel with and hostility to the academy, which amounted almost to a monomania, and lasted the whole of his life. He established independent exhibitions of his own, the lists of which show a considerable series of great and laborious works, which secured the painter but a very variable success in his speculations, though on the whole he had quite his share of both public and private patronage. His works all suffer from imperfect execution. Haydon was aware of this at one time, and for a period devoted himself to the study of the Elgin marbles—then recently brought to England—in order to overcome these defects, wholly without success however. "The Banishment of Aristides," and "Nero watching the Burning of Rome," illustrating the evils both of democracy and despotism, were Haydon's last works (1846), and the disappointment he felt at the failure of their exhibition at the Egyptian Hall was the final weight which crushed him. One of the last entries in his diary is—"Tom Thumb had 12,000 people last week, B. R. Haydon 133½ (the half a little girl). Exquisite taste of the English people!" He was greatly involved in debt, and at last his energy sank under his accumulated difficulties, and on the 22nd of June of this year (1846) he shot himself. He passed twice through the insolvent court—in 1823, only two years after his marriage, and in 1836. It is true he sometimes lost by his exhibitions, but he sometimes also gained large sums—as in 1820, when he made nearly £3000 by his picture of "Christ's Entry into Jerusalem." Latterly he combined literature with painting; in 1840 he gave some gratuitous lectures on his art at the Ashmolean Museum, Oxford, and from this time frequently delivered these lectures. They have since been published, "Lectures on Painting and Design" (two vols. 8vo, London, 1844-46). As regards Haydon's suicide, he seems to have meditated on this matter some years before he actually destroyed himself. In his diary for 9th July, 1841, is the following entry—"It may be laid down that self-destruction is the physical mode of relieving a diseased brain, because the first impression on a brain diseased, or diseased for a time, is the necessity for this horrid crime. There is no doubt of it." His own brain was diseased in the opinion of Dr. Elliotson and Mr. W. J. Bryant, who made a *post-mortem* examination of his head. Some have assumed Haydon to have been a martyr to the cause of high art; but his life is a contradiction of this. He had no enemy but himself; he was the victim of the impetuosity and inordinate vanity of his own mind. As a painter, also, he was impulsive and desultory, and neglected all the most essential and common elements of excellence in his execution. Though he numbered at one time some of our most distinguished painters among his pupils, as Sir Charles Eastlake, Sir Edwin Landseer, and George Lance the fruit painter, he served rather as a warning to them than otherwise, and his efforts have remained wholly without influence on the art of his time.

HAYLE, a small port in Cornwall, on the Bristol Channel, and a station on the West Cornwall Railway, 7½ miles N.E. of Penzance and 320 from London. It has a convenient harbour, and a breakwater and artificial channel with entrance gates, affording a safe anchorage and landing-place for vessels of 200 tons. The coasting trade is more extensive than at any other port in the county; the imports are chiefly timber and wood, corn, flour, and dried fruit; and the exports, tin and copper. Steamers ply regularly to Bristol. Iron and wood shipbuilding is carried on to some extent.

HAY'MON or **AYMON, COUNT**, and his four sons are half-mythological figures of the time of the Emperor Charlemagne. The famous old French romance by Huon de Villeneuve, who flourished under King Philip Augustus, gives the whole legend under the title of "Les Quatre fils d'Aymon." Ariosto also introduces these sons, especially the youngest one, Reinhold, in his "Orlando Furioso." Both Haymon and his sons spent their lives, according to the legend, in a series of contests against the great emperor, aided by a magic horse, Bayard, which was fetched from Satan himself by a relative, a magician named Malagis, the procuring of the horse being one of the simplest of the services he rendered. When, at the close of incessant turns of fortune and hairbreadth escapes, the emperor offered to pardon the family if Bayard were given up to be drowned, Reinhold, overborne by the prayers of the women and children, consented; but flinging his sword into the river where Bayard sank he vowed never to touch sword nor horse again, and set off for the Holy Land, there to fight the paynim with a club for his sole weapon. Eventually he returned and joined in the building of Cologne Cathedral. His industry vexed the ordinary builders, who threw him into the Rhine. His body floated, and when drawn to shore

performed such miracles that it was regarded as the body of a saint. The emperor ordered it to be brought to Aix-la-Chapelle, but when it was placed upon a waggon the wheels rolled of themselves to Dortmund in Westphalia. There, then, a church was built, the Reinaldi Church, which we still know. The date of this miracle is given with precision as 7th January, 811. The names of the other sons of Haymon were Richard, Adelhart, and Wichart.

HAY'NAU, JULIUS JAKOB, BARON VON, was born at Cassel in 1786, entered the Austrian army in 1801, and rose through the various military grades until in 1844 he became field-marshal lieutenant. In the Italian wars of 1848–49 he was remarkable alike for military talent and for merciless severity. Transferred to Hungary in June, 1849, Haynau exercised almost absolute sway for a year, and his rule was a veritable "reign of terror:" his atrocious treatment of the defeated Hungarians, and especially his alleged flogging of women, exciting the hatred and detestation of Europe. He visited London in 1850, when the workmen at Barclay & Perkins' Brewery assaulted and mobbed him, and he barely escaped with life. Few men blamed them very severely, and the British government declined to give any satisfaction for the assault. Haynau wandered over the Continent, and narrowly escaped another beating at Brussels. At Paris the police protected him, but he was hated and shunned as an outcast. Returning to Germany he died in the autumn of 1853.

HAY'TI, known also under the names of *St. Domingo* and *Hispaniola* (*i.e.* Little Spain), is one of the Greater Antilles, or Leeward Islands, of the West Indies. It extends from 68° 30′ to 74° 30′ W. lon. Its greatest length is about 400 miles. It lies between 18° and 20° N. lat.; but a promontory on the southern coast projects about 20′ beyond 18° N. lat. The area is 28,000 square miles. A census of the population does not exist; the inhabitants, nine-tenths of whom are negroes and the rest mulattoes, with very few of European descent, are calculated by the best authorities to number about 572,000, while official estimates give them at 800,000. Hayti was formerly the most fertile island in the West Indies. Near the centre of the island there is a mountain-knot, called Cibao, whose elevation does not fall short of 8000 feet. Ranges of mountains, which rise from 2000 to 5000 feet, occupy the greater part of the island, but contain between them extensive valleys and plains. In the eastern part of the northern plain are extensive savannahs or natural meadows; but towards the west the soil is fruitful. At the eastern extremity is the lake called Laguna de Henriquillo, which is 50 miles in circuit. The country is watered by numerous rivers.

The coast, which is about 1200 miles in length, has a great number of harbours, some of which are spacious, deep, and safe. Near Cape St. Nicolas is the port of St. Nicolas, which is 6 miles long, and is capable of holding a large fleet. The harbour of the town of St. Domingo is a very indifferent one.

The climate of Hayti (which is a very unhealthy one for Europeans) differs considerably from that of the other Antilles. In July begin the abundant rains on the south coast, which continue through August, September, and October. The winter is rather cool, the thermometer rarely exceeding 70°, and still more rarely descending below 60°. The northern coast has only showers during August, September, and October, but in December and January the rains descend in torrents; afterwards they are moderate, and cease entirely in April. The heat of the summer is moderated by the prevailing northern winds. Hurricanes are frequent on the southern coast, but they occur rarely on the northern shores.

In the last century Hayti was noted for its extensive plantations of sugar, coffee, and cotton, but they are much reduced. The mango and the bread-fruit trees are now important articles of food. The principal commercial wealth of the island is at present derived from the forests which cover the greatest part of the mountains. The timber consists chiefly of mahogany trees and different kinds of dyewoods. Gold, silver, copper, tin, iron, and rock-salt are found in the island, but the mines are now unproductive.

The aborigines are now extinct, but a considerable part of the population consists of their descendants, mixed with the blood of Europeans and negroes. The mulatto element, which is the civilizing element in Hayti, is daily losing its power, while the negroes, in their heathen degradation, are vastly on the increase.

Hayti was discovered by Columbus on the 5th of December, 1495, at which time it is said to have been divided into five states. Having taken possession of it in the name of Spain, Columbus founded the town of La Isabella on the north coast, and established in it, under his brother Diego, the first colony planted by Europeans in the new world. The city of St. Domingo, which subsequently gave its name to the entire island, was founded in 1498. The island is believed to have contained, at the epoch of its discovery by the Spaniards, above 1,000,000 inhabitants of the Carrib tribe of Indians. These were soon wholly destroyed; and their place was at first very inadequately supplied by Indians forcibly carried off from the Bahama Islands, and adventurers from Spain and other European countries, and in the following century by the importation of vast numbers of negroes from Africa. The Spaniards retained possession of the whole island till 1665, when the French obtained a footing on its west coast, and laid the foundations of that colony which afterwards became so flourishing. In 1697 Spain ceded to France half the island, and in 1776 the possessions of the latter were still further augmented. Driven by unspeakable cruelties to desperation, the negroes rose in 1791, and the greatest atrocities were committed. In 1793 Mayaca, a negro, seized Cape Haytien and massacred all the free inhabitants without distinction. In 1791 Toussaint l'Ouverture, also a negro, having organized an insurrection, took by surprise the principal places of the French colony, expelled an English army sent from Jamaica to the assistance of the whites, took possession of the Spanish part of Hayti, with the consent of the inhabitants, and became first president of the republic. He conducted the military operations and general affairs of the island with great judgment, humanity, and moderation. In 1800 Hayti was proclaimed independent; and its independence was consolidated by the final expulsion of the French in 1803. This was effected by Dessalines (Toussaint having been taken prisoner), who erected the French or west part of the island into an empire, of which he became emperor, with the title of James I. His despotism and cruelty having rendered him universally detested, Dessalines was slain in an insurrection in 1806, and Hayti was divided among several chieftains, the principal of whom were Christophe in the north-west and Petion in the south-west. In 1811 the former had himself proclaimed king, under the title of Henry I.: Petion continued to act as president of a republic till his decease in 1818, when he was succeeded by Boyer. The latter, after the suicide of Christophe in 1820, took possession of his dominions. The island remained in a very unsettled state, till the eastern or Spanish part constituted itself an independent republic, 27th February, 1844, and was acknowledged by France in 1848, and by Great Britain in 1850. It is styled the Dominican Republic. The western part or empire of Hayti became a republic in 1867, and Salnave was elected president. His reign of thirty months was a protracted period of civil war, from the effects of which the island has never recovered. Politically speaking, Sir Spencer St. John says, "the Haytians are a hopeless people, and the most intelligent and best educated among them are more

and more inclined to despair of the future of their country when they see the wreck that follows each wave of barbarism which every few years passes over their republic." The whole country is abandoned to small cultivators, whose inferior cottages are met with at every turn, and are, as might be expected from such a population, very dirty and devoid of every comfort, rarely any furniture beyond an old chair, a rickety table, a few sleeping mats, and some cooking utensils. (See "Hayti, or the Black Republic," by Sir Spencer St. John, K.C.M.G., London, 1884.)

HA'ZEL (Corylus), a genus of plants belonging to the order CUPULIFERÆ. *Corylus Avellana* is the common hazel-nut. This plant, which is a native of all the cooler parts of Europe, Northern Asia, and North America, is the parent of the many varieties of nuts and filberts now cultivated for their fruit. [See FILBERT.] It is specifically known by its husks being hispid with glands, leafy, broad, much lacerated, and rather spreading at the point, never contracted into a long tube, or divided into narrow rigid segments; by its roundish, heart-shaped, very rugose, angular, toothed, cuspidate leaves, glandular-hispid branches, and shrubby habit. *Corylus rostrata* (the horned hazel-nut) is a very distinct species, inhabiting the mountains of the Carolinas, where it rarely exceeds 3 or 4 feet in height. In gardens it is scarcely larger. *Corylus Colurna* (the Constantinople nut) is a native of Asia Minor, and known from all the other garden species by its becoming a tree. It seldom produces its nuts in this climate. Besides these there is the *Corylus ferox*, a species found in the Himalaya Mountains; it has a spiny husk and a hard shell.

HAZ'LITT, WILLIAM, the son of a Unitarian minister of the same name, was born at Maidstone on the 10th of April, 1778. When he was five years of age his father transferred the scene of his ministerial exertions to America, and remained with his family in the United States for two years. On his return to England the father became pastor of the Presbyterian congregation at Wem, in Shropshire; and it was here that the work of Hazlitt's education was commenced. At the age of nine he was put to a day-school at Wem. In 1793 Hazlitt was entered as a student of the Unitarian College at Hackney, in order to be educated for his father's profession. For this, however, he had no liking, and, having from a very early age shown a taste for drawing, it was determined that he should follow the profession of a painter. He commenced with great ardour and assiduity, cultivating metaphysics in his intervals of leisure. In 1802 he visited Paris for the purpose of studying the paintings in the Louvre, and on his return to England in the next year he made a professional tour and painted a considerable number of portraits; but he did not persevere. His notion of success was so exalted and his fastidiousness so great that he could never satisfy himself, and he determined on again changing his plans.

He now proceeded, in the autumn of 1803, to the metropolis to start on a purely literary career. He commenced his almost endless series of publications with an essay on the "Principles of Human Action," which was published anonymously in 1805, and was followed up quickly by other works. In 1808 he married a Miss Stoddart, the sister of Dr. (afterwards Sir John) Stoddart, and after his marriage retired into Wiltshire, where he continued without intermission his literary pursuits. In 1811 he returned to London, and we find his residence in a house in York Street, Westminster, which had been once inhabited by Milton, and which then belonged to Bentham.

In 1813 Hazlitt delivered a course of lectures at the Russell Institution on the history of English philosophy, and subsequently on the English poets generally, the comic poets, and the poets of the age of Elizabeth, in separate courses, at the Surrey Institution. He acted for a short time also as reporter to the *Morning Chronicle*, and after giving it up still wrote occasionally in that paper, and also in the *Examiner*. He was also, in the latter part of his life, a contributor to the *Edinburgh Review* and to some smaller magazines. His life was indeed one unintermitting course of literary exertion; and his labours brought him in a considerable income, which, however, his imprudence always quickly dissipated. His marriage was most unfortunate, and he rendered the misery of an ill-assorted union still worse by an infatuated passion he entertained for a domestic servant, who had neither beauty nor intelligence to excuse his folly. In 1822 he was divorced from his wife, and two years afterwards he married a second time. He died on the 18th of September, 1830, of cholera, and was buried in the churchyard of St. Anne's, Soho, London.

Hazlitt's principal works, besides those which have been already mentioned, are the "Round Table," in which he was assisted by Mr. Leigh Hunt; the "Table Talk;" the "Plain Speaker;" the "Characters of Shakspeare's Plays;" the "Spirit of the Age;" his "Political Essays," which are collected from different newspapers and magazines and published in one volume, with a preface by Hone; and the "Life of Napoleon," which Hazlitt himself looked upon as his great work, and which was his last. The principal merits of Hazlitt as a writer are force and ingenuity of illustration, strength, terseness, and vivacity. After his death two volumes of his "Literary Remains" were published by his son, with a short memoir, which shows much taste and good feeling, and a more elaborate biography was published by his grandson in 1867.

HE is usually called a personal pronoun; but true personal pronouns have no distinction of gender (as *I* and *we*, *thou* and *ye*), and we must look upon *he* as a demonstrative pronoun of the third person, therefore, if we wish to be accurate. Its demonstrative character can also be shown by many quotations, as "He of the bottomless pit" (Milton); "He of Denemarch" (Robert of Gloucester); "Thai of the Castel" (Barbour); "What is he at the gate?" or "They in France" (Shakspeare), &c. The full declension of the Old English *he* is as under:—

Singular.

	Masc.	Fem.	Neut.			
Nom.	*he*	*heo*	*hit*	he	she	it
Gen.	*his*	*hire*	*his*	of him	of her	of it
Dat.	*him*	*hire*	*him*	to him	to her	to it
Acc.	*hine*	*hi*	*hit*	him	her	it

Plural.

	Masc.	Fem.	Neut.	
Nom.	*hi*	*heo*	*hii*	they
Gen.	*hira*	*heora*	*here*	of them *
Dat.	*hem*	*heom*	*hem*	to them
Acc.	*hi*	*heo*	*hem*	them

* Accusative form substituted for the absent genitive.

Many things at once appear from a perusal of the above, where only the main forms, without any of the variations of separate periods, are given. First, the Bible use of *his* when modern usage requires *its* is at once explained. The *h* began to disappear from *hit* as early as the twelfth century. [See ORM.] *Its* is a modern creation, just beginning in Shakspeare, but so new as to be disavowed in the Bible of 1611. So we get in Gen. iii. 15, "*It* shall bruise thy head, and thou shalt bruise *his* heel." In the dative *it* has replaced the true dative *him*. Secondly, while the Old English declension is all formed from the stem *hi*, the modern English adds the stems *sa* and *tha* also. *She* is no older than the twelfth century, when it replaced *heo* in northern dialects, being found at its earliest in the account of Stephen, 1140. It is properly the feminine of the definite article (*seo*). Lancashire dialects

preserve the original feminine form (*hoo*), as *Hoo's sorry* for "She's sorry." Thirdly, *they* is really the nominative plural of the Old English definite article (*thâ*), and was at first *thai* (as in Barbour, quoted above). So also *them* is the dative plural of the definite article (*thâm*); the original neuter form, *hem*, being preserved in colloquial language in the familiar *'em*, as "Take 'em away," &c.

HEAD. See the separate articles BRAIN; EYE; FACE; HAIR; MOUTH, NECK, AND THROAT; SKULL; TEETH; TONGUE AND TASTE, &c.

HEAD, INJURIES OF THE. From the many peculiar and important features which they present, injuries of the head have properly received a separate consideration in all systems of surgery; for not only is the brain so essential to life that even its least injury must be regarded as serious, but the parts around and guarding it have many peculiarities. The injuries of the head are best considered as they affect the parts inclosing the brain or the brain itself.

In mere bruises of the scalp two circumstances are worthy of notice. A vessel of some size may be burst without the skin over it being wounded, in which case a most copious effusion of blood takes place, raising up the scalp from the skull, and producing rapid swelling of the whole of the upper part of the head. It needs, however, no particular treatment; no incision should be made into it, for if cold wet cloths be diligently applied the blood will be again rapidly absorbed.

A common superficial wound of the scalp needs no particular treatment. It should be closed with sticking-plaster after the hair around it has been shaved off, and it should be kept cool with pledgets of lint dipped in cold water and covered with oiled silk; but to guard against mischief to the adjacent parts, the patient should avoid all stimuli, and all exertion of either body or mind, till it is completely well. One of the most common sequels to injuries of the scalp is erysipelas of the head and face. It generally occurs in persons of an unhealthy habit, in hard drinkers, and in the full and plethoric. It commences about the third or fourth day after the injury. There is general fever, and the head and face feel very hot, and become red and swollen, appearances which increase, and after a day or two are accompanied with an eruption of small blisters, full of yellow fluid. There is no pain on touching the parts; but by the great swelling the eyes are often closed and the features almost obliterated. For the treatment of this complaint see ERYSIPELAS.

Another affection which sometimes follows injuries (and especially punctured wounds) of the external coverings of the skull, is inflammation and consequent extensive suppuration in the loose tissue connecting the tendon of the muscle covering the top of the head with the pericranium. When this affection is suspected to be coming on leeches should be put on the head in large numbers about the wound, and cold diligently applied; but if matter should form, one or more free incisions should be made through the scalp to let it out, and the part afterwards treated like a common abscess. In cases in which the bone has been exposed the same general and local treatment should be employed. When the bone itself is injured, no active treatment should ever be adopted, unless there are evident signs that the brain is suffering from compression or other remedial injury. The vessels of the dura mater may be ruptured by the jar from a blow which does not even break the skin. The blood that flows from them, accumulating between the dura mater and the skull, produces compression of the brain.

Instead of blood, purulent matter may collect between the dura mater and skull, and produce equally fatal results. This is indicated by the patient (usually some considerable time after the accident) complaining of headache, restlessness, and extreme languor; he has frequent irregular shiverings, his pulse is quick and hard, and he cannot sleep; if unrelieved by treatment all these symptoms increase, and are shortly followed by delirium, convulsions, insensibility, or paralysis, which are no distant precursors of death. A tumour forms on the part struck, and if this be opened the pericranium will be found detached to some extent from the skull.

The brain itself may suffer injury either from blood effused in it by rupture of its vessels, from compression by fractured portions of bone being forced down upon it, from wounds, from concussion, or from inflammation and its various effects following any of these injuries. The first does not differ in its symptoms from the cases of common apoplexy with effusion of blood, and admits of no mechanical treatment. The second class comprehends the most important injuries of the head—those of "fracture with depression," as they are called, and those which occasionally happen in children, in which the skull is indented without being broken. The symptoms of such an injury are insensibility, generally in direct proportion to the degree of pressure; the breathing is slow, laboured, and snoring, and at every expiration the cheeks are puffed out and elevated; the pulse is slow and irregular; the pupil widely dilated and insensible to light; the patient neither feels nor moves, and lies as if in a fatal state of apoplexy. The evident and indeed the only mode of affording relief is to remove the pressure from the brain, by exposing the fractured part of the skull, by enlarging the wound in the scalp, or making a fresh one, and taking away or elevating all the portions of bone that are depressed. Such cases, and all others in which compression cannot be mechanically relieved, can only be treated like common APOPLEXY.

The immediate consequences of wounds of the brain vary greatly, and indeed unaccountably. In some cases a very slight injury is rapidly fatal, as in those (of which many are now recorded) in which a pointed instrument has passed in through the orbit, and produced almost instant death; while in others severe and extensive injuries, as from gunshots, have been followed by serious symptoms at only a late period from their reception.

The last injury of the brain that needs particular notice is that called concussion or commotion. In its slightest degree it is merely a stunning, from which perfect recovery takes place in a few minutes; when most severe it is rapidly fatal; but even then a post-mortem examination discovers no alteration whatever in the structure of the brain. One of the most interesting points in surgery is the diagnosis of concussion from compression of the brain. As the latter seldom occurs without the former (for of course a blow which would fracture or indent the skull would violently shake the brain), compression has the symptoms of concussion, with the addition of some of the most severe which we have already mentioned. In concussion the patient is insensible only to slight impressions, for if he be loudly called to he will wake up, answer a word or two, perhaps even rationally, and then relapse into the same state. If he be severely pinched or otherwise irritated he will withdraw the part so injured; he occasionally moves his limbs; he appears, in short, as if in a sound heavy sleep like that of a drunken man. The breathing is not stertorous, but generally quite natural; the pupil is contracted and irritable; the pulse is sometimes unaffected, but in severe cases small and weak: there is nausea or vomiting, and the extremities feel cold. If the case is about to terminate fatally the whole body grows rapidly cold, the pulse becomes irregular and weaker, the breathing short and interrupted, and the insensibility increases. In treating cases of concussion much caution is needed. It has not appeared that bleeding, which is the remedy popularly expected for all such accidents, has at all diminished its primary symptoms, nor has the contrary treatment by stimulants been more successful. The patient, while suffering from the immediate

stunning consequences of the blow, should merely be kept quite warm in bed and carefully watched; if the pulse grow weaker, the extremities colder, and the other symptoms of sinking seem increasing stimulants are first called for, and should be given till he is completely roused to his former state; but if, instead of being depressed, he remains stationary, no active means of any kind should be employed.

HEAD'ACHE or **CEPHALAL'GIA.** This pain is one of very common occurrence, and it presents many varieties of form and intensity. It may be so slight as to cause only a temporary inconvenience, while sometimes it is so intense as to be positively agonizing and almost unbearable. It may be more or less confined to a particular spot, to one half of the head, or be generally diffused. It forms a prominent symptom in the progress of most acute and many chronic diseases, and generally accompanies nervous exhaustion and disordered digestion.

Headache sometimes arises from and is a sign of organic disease of the brain or of its membranes, though it is often absent in these disorders, some of which may exist for a long time without giving rise to pain, when their progress is slow. They are also usually attended with numerous other symptoms, and it is very seldom that the existence of any organic disease can be inferred from the presence of pain alone. When, however, it is more or less continuous, is always referred to one particular spot, is attended by giddiness, vomiting, and confusion of mind, there is reason to fear that such disease may be present, and professional advice should be sought.

Congestive headache may arise from an excessive flow of blood to the brain, and it is usually attended with a sense of pulsation in the ears, a flushing of the face and neck, and giddiness on stooping. It may be induced by free living and indulgent habits, or it may arise from too intense mental strain. Another form, which has been described as that of *passive congestion*, arises from the opposite causes of anæmia, exhaustion, loss of blood, over-excitement, prolonged mental exertion, or anything that tends to lower and reduce the strength. It is often called *nervous* headache, and by this name it is recognized as a common affection by all classes of society.

Many forms of indigestion are accompanied by a violent headache, with nausea and vomiting [see MEGRIM], and sometimes it is produced by the presence of a special poison in the blood. Of this kind is the headache which attends all fevers and inflammatory disorders, and in the same category must be placed the headache of rheumatism, gout, ague, and uræmia. The headache of ague is often of the kind known as *hemicrania*; it recurs at more or less regular intervals, and it affects either the brow and forehead, or exactly one half of the head up to the middle line.

With respect to the treatment of headache, the means adopted must necessarily depend upon the peculiarities of each individual case. Where it arises from active congestion and plethora, depletion, mild aperients, and limitation of diet are suitable remedies; but if the pain is caused by debility, tonic medicines, such as quinine, iron, arsenic, &c., with nourishing articles of diet and stimulants, are required. Many of the more obstinate forms of headache can only be relieved by strict attention to the general health, care in diet, the avoidance of all exciting causes, and habitual exercise in the open air. Of local measures for the relief of headache the application of iced water, cold lotions, or eau-de-Cologne will sometimes do good. In neuralgic headache and that caused by rheumatism of the scalp, sponging or douching with warm water often gives great relief, and having the hair vigorously brushed with the circular machine brush used by hairdressers has been recommended for the same purpose. Compression of the temples by means of a couple of pads and a bandage, the use of sustained pressure round the head, and the holding of the arms high above the head are also measures that may afford temporary relief.

HEAD'BOROW, a term applied by the Saxons to the head of the frank-pledge in boroughs. He was the chief of the ten pledges, as the other nine, being inferior pledges, were designated *handborows*.

HEADON BEDS are the lowest members of the OLIGOCENE series in Britain. They occur in the Hampshire Tertiary basin, resting conformably on the top of the Eocene deposits. They consist chiefly of green shelly sands and limestones, and are sometimes classed as the upper beds of the EOCENE. They have been subdivided as follows:—

Upper Headon.—The uppermost marls containing an abundance of fossils, as *Cerithium lapidum*, and numerous other forms; they are of fresh-water and brackish origin, and contain Potamomya.

Middle Headon are of brackish water and marine origin; fossils numerous, *Cytherea incrassata* (Venus bed) and *Neritina concava*. This band serves to correlate the British with the continental Tertiary rocks.

Lower Headon.—Fresh and brackish water beds. *Cyrena cycladiformis* is a conspicuous fossil.

The total thickness of the Headon beds varies from 133 feet at Headon Hill to 175 feet at Whitecliff Bay. *Paludina lenta*, *Planorbis euomphalus*, *Limnæa longiscata*, and some others, are characteristic of the fresh-water beds; *Potamides cinctus* and *Potamomya plana*, of the brackish-water beds; and *Cytherea incrassata*, of the marine portion. The occurrence of *Chara Wrightii* is also interesting, and besides the remains of crocodiles and tortoises (at Hordwell), those of an insectivorous mammal, Spalacodon, have been found.

HEALTH is that state of mind and body in which all the powers are exercised in their perfection, such powers being well organized and developed, sound and vigorous. More generally the term is used to refer to the bodily condition, and any deviation is termed disease. Absolute bodily health, though conceivable, and perhaps in some few instances attainable, is, so far as the majority of the human race is concerned, an unknown condition. Animals in their wild state appear to suffer from comparatively few diseases, and possibly if a time ever existed when the life of man resembled that of a wild animal his physical frame may have resembled theirs, and disease have been almost unknown. In the present day, however, it is found that while savages are exempt from many of the diseases incidental to civilization, and sometimes possess physical powers of a very high order, yet their mode of life has dangers peculiar to itself, rendering its duration short and precarious. In the history of the past it is abundantly manifest that wherever men have congregated in large numbers diseases have broken out in their midst, and the record of the ravages of sickness, pestilence, and plague forms an important part in the annals of every nation. That many of these arose from preventible causes was not, however, perceived until a comparatively recent period, though it is a remarkable fact that many of the laws contained in the Old Testament had a direct bearing upon the public health of the Jewish nation.

In modern times, however, hygienic science has made considerable progress, and although practice has lagged far behind discovery, important advances have been made in the way of preventing disease and dealing with it when it presents itself. In all civilized countries the preservation of the public health forms an important part of the work of the government, and in the United Kingdom the laws devised for this purpose are very numerous and extensive. Unhappily too many of them are characterized by an excessive timidity, and the fear of injuring private property or discouraging private enterprise has given them a tentative and permissive character, by which they are rendered powerless against individual greed and selfishness. This has been made strikingly manifest during late years by the revelation of the terribly unhealthy condition of many

districts in the large towns of Great Britain, and the easy manner in which those chiefly responsible for this contrive to evade all liability. Public attention, however, is being slowly awakened in connection with these matters, and there is some reason to hope that when the loss, suffering, and danger caused to the community by a disregard of the conditions of health is generally known important measures of reformation will be carried into practice.

With respect to personal health, it is sometimes considered in its relation to the three periods of human life—viz. growth, maturity, and decay. It must be observed, however, that probably no person is born in a state of perfect health, *i.e.* without some hereditary taint or predisposition to disease. This may be latent for many years, but predisposition by inheritance can be clearly traced in very many forms of disease, and it is reasonably believed to extend to many more concerning which there is less certainty. Beyond this it is certain that every period of life is attended with its peculiar dangers, quite independently of the fact that a large number of the avocations necessary to civilized society have a directly injurious influence upon health. As means of preserving a sound state of body and guarding against morbific influences, innumerable rules have been laid down by the professors of medical science, but the majority of them may be summed up as enforcing due attention to air, diet, clothing, exercise, and cleanliness.

Enough stress is never laid upon the immense influence upon health of the mental state. Remarks bearing upon this view are embodied in the articles HABIT and HAPPINESS. A condition of gloom and depression is one which not only may possibly itself bring disease, but which at once and invariably lays the mental sufferer open to any physical evil that may be lurking near him. On the other hand, a calmly cheerful habit of mind carries its happy possessor safe through a thousand dangers, and enables him (all unconsciously) to throw off the attacks of disease, for of itself it invigorates and stimulates the great digestive and nervous bodily systems.

HEALTH, BILL OF, in shipping, is the certificate of a consul as to the health of a crew when the ship has come from a suspected port. The names given to the documents representing the various degrees of health are a clean bill, a suspected bill, and a foul bill. See QUARANTINE.

Bill of Health, in the law of Scotland, is an application made to the prison board by a prisoner to be allowed to live away from the prison, of course under surveillance, on account of ill health.

HEALTH, PUBLIC. See TOWNS, HEALTH OF.

HEARING. See SOUND and EAR.

HEARSE, a funeral carriage in or on which a corpse is borne to its last resting-place. In England it is usually a closed carriage, decorated with plumes or feathers on the top and black drapery at the sides. On the occasion of public funerals, and generally on the Continent, the hearse is an open car, on which is placed a bier with the coffin, and this custom has of late years been occasionally adopted in England. See also HERSE.

HEART. The heart is the central organ of the circulation, and by its alternate contractions and dilatations is the principal power by which the blood is moved through the bodies of the higher animals, as detailed in the article CIRCULATION OF THE BLOOD. Many of the lower animals, as there described, are without a heart, and that a heart is not essential for circulation is shown by the portal circulation, or circulation of the liver, doing quite well without one. But, nevertheless, in the higher orders the vigorous impulse of the cardiac contractions seems necessary for the systemic circulation, and we find the presence of a heart practically universal.

The heart of man may be taken as the type of this circulation. It is of a somewhat conical form, having its base directed backwards towards the spine, and its point forwards, downwards, and to the left side, so that at each contraction it may be felt striking between the fifth and sixth ribs, about 4 inches from the middle line. It rests upon the diaphragm, or muscular partition between the chest and abdomen, and the surface upon which it lies is much flattened. It is firmly attached to the diaphragm at its right side and behind by the inferior vena cava, which passes through that muscle, and above and behind it is fixed, though more loosely, to the upper and back part of the chest by the rest of its great vessels, which there pass out of the pericardium and are united to the surrounding cellular tissue and organs. Everywhere else it is quite free and movable, though the range of its motions is limited by the pericardium or serous membranous bag in which it is contained, and which closely surrounds it at all times. The pericardium has two layers, which therefore inclose a thin space. This contains just enough fluid in health to facilitate the motion of the two surfaces one upon the other.

To examine the interior of the heart (a sheep's or bullock's heart being easily procurable for this purpose), it should be removed from the pericardium, and an incision should be made into the front of the right auricle, so that an angular flap may be cut out of its walls, and the whole view of the back part and sides of its interior may be exposed. There will then be seen, behind and to the right side, two large apertures; the upper leading to the vena cava superior, through which all the blood is returned from the head and upper extremities, and the lower leading to the vena cava inferior, by which all the blood is conveyed from the abdomen and lower extremities. These apertures will be seen to be surrounded by a few muscular fibres continuous with those of the auricle itself, and that of the inferior cava is partially guarded by a thin semilunar membranous fold, called the Eustachian valve, varying much in size, and often much torn. The left side of the cavity, on the partition which separates it from that of the right auricle, presents an oval depression (the *fossa ovalis*) surrounded by an elevated border, indicating the situation of the foramen ovale, through which, during the fœtal state, the blood, which was prevented by the Eustachian valve from passing into the ventricle, was conveyed directly from the right into the left auricle, and thence into the left ventricle, as described in the article EMBRYO. Lastly, at the anterior and left angle of the cavity another and the largest aperture is seen, which leads into the right ventricle, and has attached to its sides a membranous curtain, by which it is occasionally closed, and which is called the tricuspid valve.

Proceeding in the course of the circulation, a cut should be made from the right auricle through the aperture leading from it into the right ventricle, and along the front of the heart nearly to its apex, and then another from the end of the first upwards into the pulmonary artery, as it arises from the front and upper part of the ventricle. By raising the portion thus cut out, a complete view of the cavity of the right or pulmonary ventricle, and of its communication with the auricle, will be seen. The cavity of the right ventricle has a somewhat conical form, with its base uppermost, that part of its walls which is formed by the septum projecting somewhat into it. Its walls are rendered extremely irregular by prominent bands of muscular fibre. Here and there stand out short columns of muscle projecting into the interior and pointing towards the right auricle; these are called the columns of the heart (*columnæ carneæ*), and they have attached to their summits fine tendinous cords (*chordæ tendineæ*), which pass thence to be attached to the edges of the curtain-like membrane (the tricuspid valve) which guards the orifice between the auricle and ventricle. This orifice is of a broadly oval form, surrounded by a ring of firm dense tissue, to the whole interior circumference of which is attached the fold

of membrane, strengthened by tendinous fibres, forming the valve.

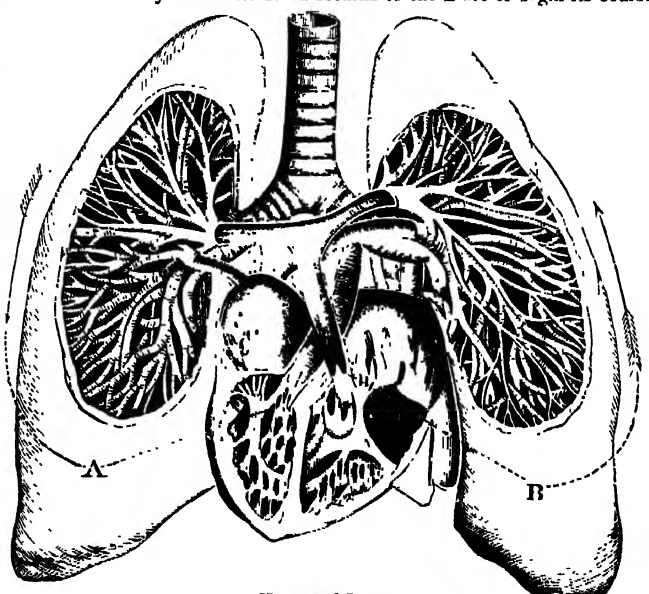
From the front and upper part of the ventricle a smooth short passage leads to the origin of the pulmonary artery, which is attached firmly to the dense ring to which many of the muscular fibres of the ventricle are affixed. At their union, and at the very orifice of the pulmonary artery, three little valves (the semilunar, sigmoid, or pulmonary valves) are seen, of a semilunar form, attached by the whole length of their convex edges to the walls of the artery, and hanging loosely in it with their free festooned edges directed upwards, inclosing behind them three small spaces, where the artery bulges somewhat outwards. These valves completely close the orifice of the artery inwards, so as to prevent any fluid from passing into the ventricle.

The left posterior or aortic ventricle and auricle differ in no important particular from the right. The walls of both cavities on the left side and all the parts contained in them are thicker and stronger than those on the right; the orifice between them is guarded by a valve which has only two principal divisions, and is therefore called the mitral valve. The aorta proceeds upwards and to the right side, then arches backwards and to the left, and, turning over the main air-tube of the left lung, passes down along the spine, at the lower part of which it divides into two large arteries (the common iliacs), which supply the pelvis and lower extremities. From the upper part of its arch it gives off the main trunks of the head and upper extremities in three large trunks; that most to the right, called *arteria innominata*, is the common trunk, which divides into the right carotid for the right side of the head, and the right subclavian for the right arm and side of the neck and chest. Next to it is the left carotid, and next the left subclavian, of which the distribution is similar to that of those on the right side.

During life the blood returning from the whole body by the veins which unite to form the two venæ cavæ enters the right auricle and gradually distends it, at the same time that the blood returning from the lungs by the pulmonary veins enters the left auricle and distends it. When completely filled, a kind of vermicular motion is seen commencing at the point of each auricle, which is rapidly propagated along their walls, and simultaneously empties the contents of the one into the right and of the other into the left ventricle. The ventricles are no sooner completely filled than they contract suddenly and with much greater force than the auricles, and propel the blood into the pulmonary artery and aorta. From the aorta the blood is propelled into the arteries, through which it is distributed to all the body and returned by the veins; but the veins of the intestinal canal and the organs connected with it unite into a large trunk, the vena portæ, which, instead of at once entering the heart with the others, passes into the liver, and there again divides into minute capillary vessels, from which the bile is secreted. These pass into the ultimate divisions of a series of hepatic veins, which collect into three or four large trunks opening into the vena cava inferior just before it passes through the diaphragm to enter the right auricle.

If we divide the whole process into five equal portions of time, one is taken up by the contraction of the auricles, two by the ventricles, and two are spent in repose before the next contractions begin. Anyone listening at the chest of another will hear two sounds, followed by an interval of silence, corresponding to these actions of the heart. The first sound is made by the sudden tension of the great valves, when the ventricles begin to contract and these valves fly together to close the auricles; the second sound is due to the closure of the semilunar valves after the contraction, when the blood closes them sharply in an effort to return to the empty ventricles. These sounds follow one another very quickly of course, since one precedes and the other follows the ventricular contraction, and they are well represented by the sounds *lūbb*, *dŭp*, the first being heavy and slow, the second a short, quick, dull snap.

From the heart the blood is poured into the arteries, a series of ramifying tubes through which the current is distributed, divided into a gradually increasing number of streams, which progressively diminish in size, till it arrives at a network of the most minute canals, the capillaries, forming the indistinguishable boundary between the arteries and the veins. The blood passing through the capillaries is collected by the veins, which run together like the tributaries of a river, collecting finally into great trunks by which the blood returns to the heart to begin its course



Heart and Lungs.

once again. See BLOOD, CAPILLARY VESSELS, CIRCULATION OF THE BLOOD.

The accompanying figure represents a section of the heart and lungs. The line A crosses the left lung and enters the left side of the heart. The course of the arrow indicates that the blood from the lungs is setting towards the right auricle, and the whole line points to the aorta, the main arterial trunk which carries the purified blood to the body. The line B passes the right lung to the right side of the heart, pointing to the pulmonary artery, and indicating by the direction of the arrow that the blood is being driven from the heart into the lungs.

Harvey considered the heart to be the sole agent by which the circulation is effected, but it is certain that several other agents exercise auxiliary powers. These are enumerated and described under CIRCULATION. That the heart has, however, an influence on all parts of the circulation is quite evident. In the larger arteries its effect is seen in the increase of the current which it has set in motion, in exact coincidence with the contraction of the ventricles; in the smaller ones, by the same increase at a scarcely appreciable interval; in the capillaries, by the

occasional pulsatile motion which may be seen in them, when, after an animal has been largely bled, its transparent parts are examined with the microscope, and this though the heart is acting very weakly. Lastly, in the veins we find its influence still exerted; for if the main artery and vein in a limb be exposed and isolated, and the latter be wounded, the flow of blood from the orifice may be exactly regulated by compressing the artery, that is, by preventing, to a greater or less extent, the blood from flowing to the vein with the impulse given to it by the heart. It appears also that, in addition to propelling the blood, the heart during its expansions draws up the blood, so that it acts both as a sucking and a forcing pump.

The average weight of the human heart is from 9 to 10 ounces. It increases throughout life till old age, when, like most of the organs, it shrinks by senile atrophy. The vitality of this little organ is something incredible. It continues its unceasing rapid throb for many long years, at the rate of from 70 to 75 pulsations a minute in adult life, and the very slightest relaxation is at once felt in dangerous faintness, while a total stoppage of the most moderate length causes death. At birth the pulsations amount to a flutter, 140 times a minute, and gradually lessen to 100 during the first three years. At seven the pulse is 85, and at fourteen 80 or thereabout. In old age it sinks frequently to 60. The pulse of women is more rapid than that of men, and that of full men than that of fasting, and of sleeping men than of waking.

HEART, DISEASES OF. In common with all other important organs the heart is subject to a variety of disorders, which may be either functional or organic, and either such as affect it as a whole or such as affect its various parts. In former times very little was known of the nature of the diseases of the heart, but after the discovery of the circulation of the blood the attention of physicians was directed to the subject, and some important discoveries were made. The application of auscultation and percussion to the purpose of diagnosis added very materially to the accurate knowledge of the subject, which, by the labours of Corvisart, Laennec, Stokes Hope, and a large number of later physicians, has been very fully investigated.

Concerning the functional disorders of the heart one of the most important has already been referred to [see ANGINA PECTORIS], and a more common, but generally less serious affection, viz. syncope, has been considered under FAINTING.

Palpitation of the heart implies the existence of abnormal movements, an increased force or increased frequency, or an increase both in force and frequency in its systolic contractions. Sometimes there is a single abnormal beat, which generally occurs during the first sleep at night, and is sufficient to awake the patient, but more frequently the attacks are prolonged, usually sudden in their onset, and they come on at irregular and uncertain intervals. In many cases a few rapid and feeble pulsations are followed by others that are fuller and slower, or one or more beats are missed to be followed by one of unusual strength, and occasionally the beats are so violent as to appear to cause the heart to strike the wall of the chest, and even to agitate the whole body. Beyond a dull aching sensation there is usually but little pain; but palpitation is often accompanied by sensations of choking, giddiness, impaired vision and pain in the eyeballs, headache, and a feeling of great anxiety. Persons of nervous and excitable temperaments are chiefly the subjects of palpitation, hence it is more common among women than men. It may be induced by anything that causes debility, while it often depends upon a disordered condition of the stomach; in fact the latter condition is perhaps a more frequent cause of this affection than any other. Palpitation is often the cause of much anxiety on the part of the subject, who imagines it to arise from some serious organic disease, and to imply a liability to sudden death; but in the great majority of cases no serious danger is to be apprehended, and the complaint readily yields to suitable treatment. The latter must evidently be guided by the circumstances of the individual case, and must consist in a removal of the exciting cause and the strengthening of the nervous system. During an attack the recumbent posture, a loosening of the clothing round the shoulders and neck, the admission of fresh air, and mental and bodily quiet, are the best remedial measures, though sometimes in addition a little stimulant may be administered with considerable benefit. In connection with the removal of the exciting causes it may be mentioned that the immoderate use of tea and tobacco frequently give rise to palpitation of the heart, and where this is the case abstinence from these articles may be sufficient to remove the affection.

Organic diseases of the heart, which are very numerous, arise chiefly from three great causes, and they are either congenital, or resulting from rheumatic fever, or due to some form of degeneration. In Great Britain, owing to the changeable climate, rheumatic fever is a very prevalent complaint, and its chief danger is the influence it is liable to exert upon the heart. Sometimes, though very seldom, scarlet fever will affect the heart, and disease is occasionally brought about by a severe strain, such as that caused by violent athletic exercise, the lifting of heavy weights, &c. Disease of the heart is diagnosed by constitutional and local symptoms, and among the former may be enumerated pain in the chest, palpitation, difficulty in breathing, cough, dropsy, an irregular pulse, and a blueness of the face and lips. The local symptoms are distinguished chiefly by means of auscultation and percussion. Among the principal organic diseases of the heart the following may be enumerated:—

1. *Pericarditis* (inflammation of the pericardium, the serous membranous double sac which invests the heart) resembles much, in its pathological conditions, inflammation of other serous membranes, and is induced by similar causes, as exposure to damp and cold. It of course presents peculiar symptoms, arising from the situation and nature of the individual organ; thus the patient will complain of tenderness over the region of the heart, amounting, when pressure is made, to acute lancinating pain, which prevents him from lying on the left side, and is much increased by drawing deep inspirations, or coughing, this latter symptom frequently depending on the pleura being involved in the inflammatory attack. This pain, however, is not always so severe; frequently only a sense of oppression is felt. pulsations of the heart are frequent, sometimes regular, but at other times intermittent, and so strong as to constitute palpitations; but still, if much effusion has taken place into the pericardium, the hand when applied to the chest will have difficulty in perceiving them. The precordial portion of the thorax is often bulged out by the forcible action of the heart, and the quantity of fluid effused into the cavity of the pericardium. This effusion varies much in quantity and consistence at different periods of the disease: thus in many cases only a little bloody serum will be found; in others, pus in large quantities, coagulated lymph, bands of fibrinous matter uniting the two layers of the serous membrane, and even cartilaginous or osseous deposits. The dull sound discovered by percussion in the precordial region of a person in health is always, in this disease, increased in proportion to the quantity of fluid in the pericardium, and, in proportion as this fluid becomes organized, sounds will be heard by the application of the stethoscope, and often of the unassisted ear, varying in their nature according to the state of the organizing process, and resembling at one time the creaking of new leather, at another the rubbing together of paper or parchment, the noise made by a file, &c. Other sounds also are frequently heard, which depend

upon the disease being accompanied by lesions within the heart itself. This disease frequently accompanies acute rheumatism, and forms one of the worst features of that very common affection. Serum is sometimes found in the pericardium independent of inflammation, constituting the disease known as *hydro-pericardium*.

2. *Endocarditis* (inflammation of the interior lining membrane of the heart).—This disease is not very frequently met with uncombined with some other inflammatory disease; rheumatism, pericarditis, carditis, or inflammation of the internal coat of some of the veins will be usually found, if not to accompany, at least to have preceded it. The principal symptoms of endocarditis are more or less fever and anxiety; some bulging of the precordial region, if accompanied by pericarditis; an extension of the dull sound heard on percussion in the healthy state; the pulsations of the heart unusually strong, and sometimes very rapid and intermittent, repulsing the hand when applied to the chest, and producing a peculiar vibratory sensation. Upon auscultation the bellows' sound will be heard, masking one or both of the normal sounds. The causes of this serious malady are similar to the causes of pericarditis, and the treatment must be such as tends to diminish the intensity of the inflammation, and to limit the extent of surface involved.

3. *Myocarditis* or *Carditis* (inflammation of the heart).—The proper muscular structure of the heart is not free from the attacks of inflammation; but where this disease exists there will also be found traces of it in the pericardium, or in the lining membrane of the heart, or in both; and we cannot point out symptoms of the one distinct from those of the other disease: the treatment, consequently, is similar in both.

The above are the chief forms of inflammation to which the heart and its membranes are liable. Other structural diseases are:—

4. *Hypertrophy of the Heart.*—Independently of any morbid process existing in itself, the muscular structure of the heart is often greatly increased in bulk, as if the nutritive process were too active in proportion to the absorbent, and new matter were deposited more rapidly than the old could be removed. From the peculiar nature of the functions of the heart, this disease becomes very important, and its effects not less dangerous than manifold. It is usually divided into three kinds: namely, *simple hypertrophy*, the least common, in which the parietes are thickened without any change of capacity in the cavity; *eccentric or aneurismal hypertrophy*, the form most frequently met with, in which the parietes are thickened and the inclosed cavity or cavities proportionally enlarged; and *concentric hypertrophy*, where the cavity is diminished in proportion to the thickness of the parietes. Any one of these kinds of hypertrophy may affect the parietes of either cavity of the heart, or the whole organ. The extent to which this increase of size may proceed is enormous; hearts have been found weighing upwards of 20 oz., whereas the average weight of a healthy heart is from 7 to 9 oz. In hypertrophy the chest is often bulged out towards the left side, the sound produced by percussion more dull than in the healthy state, and the pulsations very strong; indeed the bed-clothes are often visibly raised, and the head or hand of the observer, when applied to the chest, forcibly repulsed, yet the pulsations are for the most part regular, unless palpitation be induced by over-exertion. The sounds perceived by auscultation are louder than natural. Hypertrophy of the left ventricle of the heart sometimes brings on apoplexy and hæmorrhages. This is a disease in which great perseverance is required on the part of the patient and the practitioner, but with proper care it frequently admits of much alleviation. Rest, abstinence, sedative medicines, and attention to nutrition and the state of the digestive organs are very efficacious.

5. *Dilatation of the Heart.*—It has been shown that the heart may be increased or diminished in substance, or may be hypertrophied or atrophied. The whole substance of the heart, or either of its cavities singly, or the orifices of these cavities, may be dilated, the solid parietes being merely extended, without any increase of substance, and the contained cavities proportionally enlarged. As in hypertrophy so in this disease, according to its extent the shape of the heart will be much changed. The muscular parietes being thinned and feeble, the circulation of the blood will not be carried on with vigour, and the patient will be weak and unfit for exertion, easily exhausted by small losses of blood, and sometimes carried off by what under ordinary circumstances would be deemed a trifling hæmorrhage. Excessive exertions and strong passions seem to be exciting causes of this disease, and from the influence of these causes the patient should be sedulously guarded, and, at the same time, every remedy must be adopted which may contribute to equalize the circulation.

6. *Atrophy of the Heart* (wasting away of the muscular substance) has also been observed accompanying a state of general debility of the system.

7. *Ruptures of the Heart.*—Ruptures are sometimes found to occur, not only in the valves and columns of muscular fibres within the heart, but also in its parietes. The effect of such injuries will depend upon their extent and situation. A valve, or one of the bundles of muscular fibre, cannot be broken through without causing much inconvenience to the free circulation of the blood; but it seldom happens that the parietes of either cavity of the heart are sufficiently injured to allow the free passage of blood into the pericardium without instant death being the consequence.

8. *Disease of the Valves.*—The internal lining membrane of the heart is often thickened, especially at the valves; and after repeated attacks, or a long chronic form of endocarditis, the valves will not merely be thickened, but will become the seat of a variety of warty excrescences, or even cartilaginous and osseous formations of considerable size, extending into the cavities of the heart. This ossification is most frequently met with in old persons, and especially those who have been addicted to excess in their mode of living. The morbid sounds produced by these obstructions at the various orifices will resemble those of the bellows, file, or saw, according to the degree of the obstruction; and sometimes a triple or even a quadruple sound will be perceived instead of the two normal sounds. The effects of these obstructions will be sanguineous and serous congestions, oppressions of the breath, apoplectic seizures, and other symptoms of embarrassed circulation.

9. *Persistence of the Foramen Ovale.*—It is not altogether uncommon to meet with cases in which the opening leading from the right to the left auricle of the heart has not been properly closed up at the time of birth. According to the extent of the communication thus remaining, a greater or less proportion of venous blood will pass into the left side of the heart, and, being there mixed with red blood, circulate through the arterial system. The symptoms of this disease are blueness of the skin, lips, and nails; a temperature of the body below that which is natural and healthy; shortness of breath, palpitations, faintings, a sense of suffocation induced by slight exertion, and sometimes a great disposition to hæmorrhage and depression from small losses of blood. This disease has, from the colour of the skin, been named "blue disease," "morbus cæruleus," or "cyanosis."

HEART-COCKLE (Isocardia) is a genus of bivalve molluscs belonging to the class LAMELLIBRANCHIATA and family Cyprinidæ. As the name denotes, the shell is heart-shaped. It is ventricose, equivalve, smooth or furrowed externally, with prominent contorted beaks, and a hinge consisting of two very oblique cardinal and two

lateral teeth in each valve, the anterior being sometimes obsolete. The ligament is external. The gills are very large. The heart-cockle burrows in sand, forcing its way by means of its sharp-pointed, triangular foot, and leaving only the siphonal openings exposed. Only five species are known, one of which (*Isocardia cor*) is an inhabitant of the British seas and the Mediterranean, and the others are natives of China and the Philippine Islands. Ninety fossil species of this genus have been described, dating from the Trias downwards.

HEART-URCHIN is the common name for species of echinoderms belonging to the family Spatangidæ, of the class ECHINOIDEA. They are found on British coasts burying themselves in the sand. The tests are heart-shaped, the mouth not central in position, and the jaws absent.

HEART'S-EASE or **PANSY** is the cultivated state of the plant called *Viola tricolor* by botanists, improved by crosses with *Viola altaica* and other allied species.

Several hundreds of beautiful varieties are now common in gardens. Although they will all grow in almost any kind of soil, yet, in order to bring the finer sorts to any degree of perfection, a loam, mixed with sand and highly manured, is absolutely necessary. By proper treatment they may be had in full flower at two different seasons—from April to June, and from September until the frost destroys them.

The original species from which all these varieties sprang are easily preserved; but this is not the case with many of the finer sorts, which, as in animals and in other plants, the higher they are bred and the finer the kinds, are in proportion difficult to keep in health. The principal causes which affect them are excessive heat in summer and wet and cold in winter. They are, however, easily propagated, and only require to be looked over frequently, when, if any of them are found damping or decaying at the bottom of the stem, the top must be taken off and struck. When there is danger of losing any of the sorts during winter, the best way is to strike a quantity in autumn, and to place hand-glasses over them until spring; at that time those which are alive may be soon multiplied in abundance.

Where fine large flowers are wanted, the plants should always be struck from cuttings the same season, and grown rapidly. In striking them artificial heat is altogether unnecessary, unless when the operation is performed early. All that is required for the purpose is a small hand-glass to place over the cuttings, and a mat to shade them during bright sunshine. After they are well rooted they must be taken carefully up and planted in a bed previously prepared for them. They will then flower in great profusion from April to June.

Varieties are obtained from seed. In order to have them fine considerable care is requisite in selecting the seed. It must always be gathered at those seasons when the plants flower in the greatest perfection, and from the best formed and largest blossoms. They will generally be found in this state in the early part of the season, from April to June, or in autumn, after the greatest heat of summer is past; at other seasons the flowers are smaller, and it is found that this affects the seed. The seed should be sown in spring, in light soil, with the protection of a cold frame. When the plants are very young they must be removed from the frame and planted thinly under hand-glasses, where they will remain until they are sufficiently strong to be planted out in the flower-garden. At every shifting they must have plenty of water, and be carefully shaded during bright sunshine.

HEAT. What heat *does* we know very well—it causes bodies to expand, it converts solids to liquids and liquids to gases, it creates electrical currents, it causes or promotes chemical action, &c.; in fact there is nothing more familiar to us. Besides, everything we touch is not only *hard* or *soft*, but it is at the same time, and probably to the same nerves, *hot* or *cold*—the sensations of hardness and warmth are simultaneous. The power of perception of warmth or coolness is present with us from birth, before either sight or hearing is consciously possessed. Here it is observable that we use the same word for the sensation of heat which we derive from the nerves of the skin and for the unknown cause of that sensation, the heat of the warm body we touch. There is no practical harm resulting from this confusion; it merely therefore needs a passing word of caution.

But it is quite another thing to ask what heat *is*. We know, at all events, one thing that it *is not*, namely, a substance. The old-fashioned idea that *caloric* was a substance, the presence of which made bodies hotter and the absence of it cooler, which was seen to fly off from the red-hot iron of the forge or from the wood on the domestic hearth, is now quite given up. A simple experiment demolishes it for ever. The sun is the most important natural source of heat which our system possesses, its heat when condensed in the focus of a lens being exceedingly intense. When concentrated by a number of powerful lenses on one scale of a balance of extreme sensibility, no derangement of equilibrium ensues; the increase or diminution of heat in any body is unaccompanied by any alteration of weight. Heat (caloric) therefore cannot be a substance of even the lightest gaseous constitution.

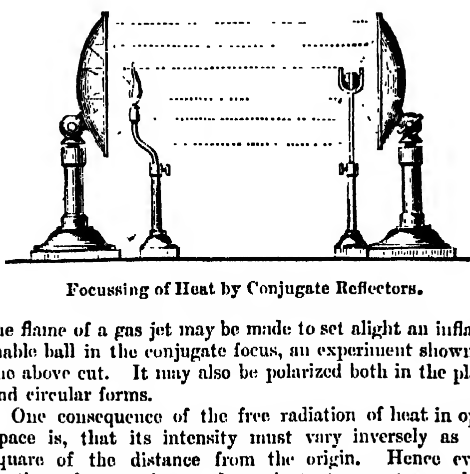
Professor Tyndall's excellent little book, "Heat as a Mode of Motion," sets an alternative hypothesis in the most inviting light. It may be taken, indeed, as the working hypothesis now, to the exclusion of any other; and philosophers universally regard heat (as they do sound, light, and electricity) as a *mode of molecular vibration*. Heat is transmitted, according to these views, by vibrations of the imponderable fluid called ether, which as yet it is expedient to assume fills the whole universe with an elastic medium for this purpose, serving as well for the transmission of the quicker and more subtle vibrations of light, and it may be of electricity also. Sound is transmitted by the vibrations of matter, as air, water, wood, metals, &c.; but heat and its congeners need no such coarse medium. What ether is we know not, nor even if there be ether, but we postulate it merely as the wherewithal to construct the waves of vibration, which waves we may almost confidently assert really do exist.

This mode of molecular vibration may be thus imagined. If we suppose the molecules of a body to be in a certain state of tension, then it is evident that when these molecules are set into vibration by added heat, which we assume to be simply added vibration, the body will expand and will be likely to pass from the solid to the liquid, from the liquid to the gaseous form. Further, such vibrations will be readily communicable to adjacent bodies or to the circumambient ether. But all bodies have at any given time a certain measure of heat. There is no true *zero* of heat; Fahrenheit's *zero* is now absurdly warm compared with easily producible amounts of cold (not known in his day), and the *zero* of the centigrade scale of Celsius' thermometer only pretends to be a convenient starting-point for measuring heat; it is simply the temperature of melting ice, and does not at all assume to be the beginning of heat. Are we then to say, in face of this, that all bodies at all times are in a state of vibration?—not that an addition of heat sets the molecules in vibration, but rather that it increases the vibration of the already vibrating molecules? Yes, that is indeed the fact that modern physicists firmly believe. We are taught to regard *solid* bodies as made up of molecules vibrating each of them round a certain fixed position, the exact form of that vibration being quite undetermined as yet, possibly indeterminable. Increase of heat would mean that the excursus of each molecule was greater in each vibration; decrease of heat would mean a lessening of the excursus made during each vibration. In *liquids* the state of vibration is so far altered as that the molecules have no

fixed position, but easily move upon one another, and readily separate at the bidding of external force, at the same time tending, even when so separated, to hold together in drops, whose size and form vary with the circumstances of their production. [See DROP.] But in *gases* the vibration of the molecules is so great that even at the lowest temperature consistent with the gaseous form, they tend to drive one another apart and fly asunder in straight lines in all directions, pressing upon the walls of any vessel that may contain them. The effect of heat upon a gas is to increase the elastic pressure so exercised to a very great degree. At the same time there are limits to the elasticity of a gas though we do not yet know them. Otherwise the earth's atmosphere would gradually dissipate itself into space, which we know does not occur. It may be that when the earth's gravitation equals the elasticity of the gas the latter is retained. But these considerations are too remote from the present purpose. Gaseous bodies must be regarded ordinarily as perfectly elastic, that is as occupying any certain space only under some definite pressure, however small.

From this view of heat it follows that it may at once be produced by anything which changes the motion of a body into the motion of its particles; hence friction, hammering, percussion, sudden condensation, chemical combination, and electrical discharges are all proper to produce or rather to develop heat. For, taking the case of friction, here we have motion checked, as with a skidded wheel. The motion of revolution is still potentially there, but it is shown in the motion, or vibration, or tremor, of the particles of the wheel—that is, the heat of friction—instead of in the motion of the wheel as a whole.

Radiation.—Heat radiates from all bodies in straight lines and in all directions, and in the law of its emanation it resembles light, its intensity diminishing in the same proportion as the sine of the angle of emanation. If we conceive two balls which are heated unequally to be inclosed by a concave surface, which by any means is preserved at a uniform temperature, the radiation of heat from the warmer ball directed on the colder, being more copious than the radiation from the latter on the former, the temperature of the hotter will sink and of the cooler rise, in proportion to the difference of radiations; and this will continue until the temperatures become permanent, in which case the radiations are necessarily equal. Radiant heat from a red hot ball may be concentrated by a suitable lens, and may be reflected between conjugate foci (see Plate, fig. 20) in exactly the same way as light. Or, similarly, the heat of



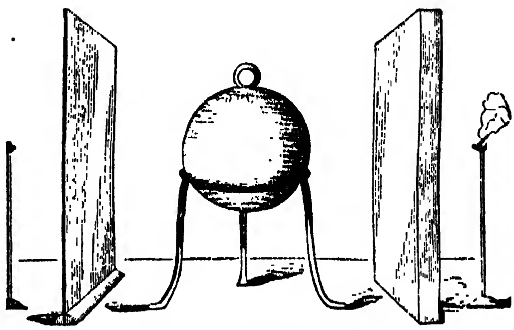
Focussing of Heat by Conjugate Reflectors.

the flame of a gas jet may be made to set alight an inflammable ball in the conjugate focus, an experiment shown in the above cut. It may also be polarized both in the plane and circular forms.

One consequence of the free radiation of heat in open space is, that its intensity must vary inversely as the square of the distance from the origin. Hence every portion of space has a determinate temperature, which is due to the amount of radiation, not only from the sun and fixed stars, but also from the non-luminous bodies of each system.

But though the laws of the free emanation of heat and light are similar, those of their transmission through substances are very different. When a metallic body is but a little heated in a fire, we have heat unaccompanied by sensible light; and in the lunar rays the light, though originally transmitted from the sun, arrives at our planet with scarcely any sensible heat, even when collected in the focus of a burning-glass and measured by a sensitive thermopile. It is still more remarkable that, when the solar rays are decomposed by transmission through a glass prism, the differently coloured rays of the spectrum have each a different intensity of heat, the least refrangible possessing the greatest portion. The greatest heat is found at the place occupied by the extreme red rays, or rather a little beyond them. See HEAT SPECTRUM.

Diathermancy, or transparency to heat, is possessed by bodies in quite a different ratio to their transparency to

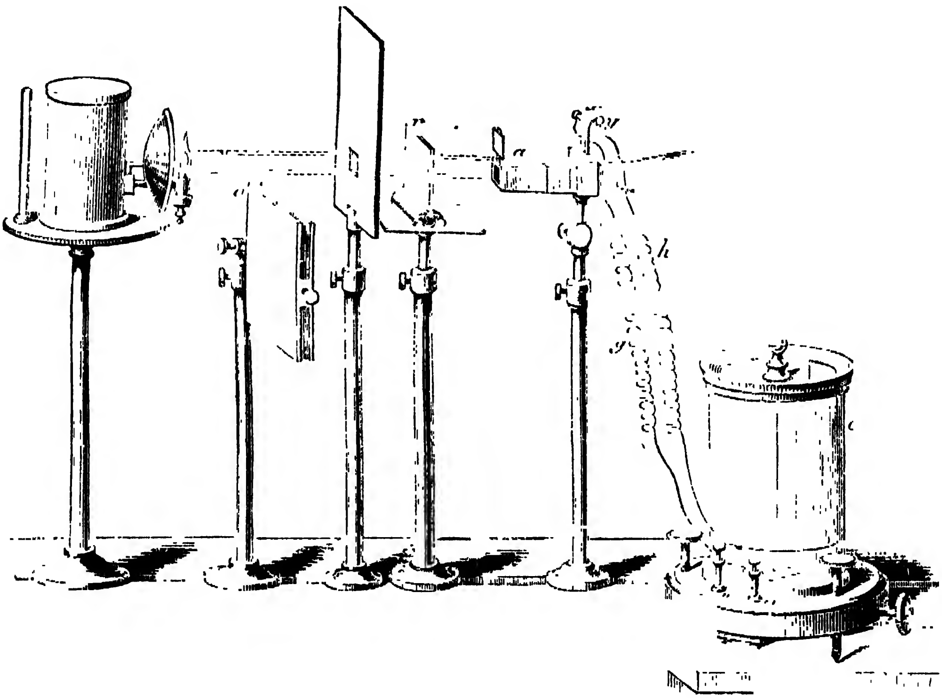


Experiment to show Diathermancy.

light. The transparent amber is almost *athermanous*, while the smoky rock crystal, which is only translucent, not transparent, is almost perfectly diathermanous. This may be very effectively shown by placing on either side of a ring-stand a thin plate of amber (or other athermanous substance) and a thick plate of rock crystal (or other diathermanous substance), and beyond them two particles of some easily inflammable matter, suitably disposed, as in above figure. If now a red-hot copper ball be dropped into the ring-stand, the particle protected by the thick plate will quickly catch fire, while that beyond the thin plate will be thoroughly preserved. But when we employ heat obtained from a terrestrial source, we discover that the phenomena not only differ from those which result from the transmission of celestial heat, but differ among themselves to an extent which at first seems to preclude all classification. Thus, while glass arrests scarcely any portion of the direct solar heat, the thinnest plate of it interposed between us and an intense fire acts as an effectual screen. This fact affords to the glass-maker a convenient mode of protecting the eyes, when it is necessary to inspect the interior of his glowing furnace. It is not, however, correct to say that none of the heat from such a source is transmitted by the glass. This was the received opinion, and glass screens were held as effectual as opaque ones in arresting the heat of a fire; but it is now ascertained that a variable portion of terrestrial heat, depending upon the temperature and nature of the radiating body, does pass through. The fact is, however, more strikingly illustrated by the flame which is obtained by the combustion of a mixture of oxygen and hydrogen gases. In this flame we have the greatest artificial heat known except the electric lamp, although accompanied by very little light. If a convex lens be held before it, the heat

transmitted through the glass, even when thus concentrated, can scarcely be appreciated by the most delicate air thermometer. But if a piece of lime be placed in the flame, where it undergoes no chemical change, but emits a light which in point of intensity almost rivals that of the sun, radiation of heat immediately takes place, sufficient to inflame a piece of phosphorus placed in its focus.

Thermopile.—This instrument was invented by Melloni, and is indispensable for investigating small increments of heat. It consists of an arrangement, shown below, of several pairs of antimony and bismuth bars, placed in a brass case, *a*, and having the wires, *x y*, *y h*, from its poles connected with a very delicate galvanometer, *c*. The extremities of the bars being exposed to any source of radiant heat, as that from a coil of platinum heated by a spirit-lamp, while the temperature of the other extremities of the bars is not altered, a current of electricity, proportional to the quantity of heat falling upon the exposed extremities of the bars, passes through the wires from the poles of the pile, and causes the magnetic needle of the galvanometer to deflect more or less, according to the quantity of electricity circulating. In a little frame *r* is placed the substance whose action upon the rays of heat is to be tried. This is situated immediately behind a screen, having an aperture in it somewhat smaller than the plate through which the heat is to be transmitted. Sometimes other precautionary screens are employed to protect the pile from irregular radiation and other disturbing causes on the end next the galvanometer, and as it is important that the action of the heat upon the bars be limited to the actual time of the experiment, the double screen, *o*, is interposed immediately between the transmitting screen and the lamp, so that,



The Thermopile.

being provided with a hinge, it may be raised or lowered whenever the rays of heat from any source are to be allowed to pass or are to be intercepted. It is obvious from this arrangement that no heat from the radiating body can reach the pile, except through the substance placed behind the aperture in the screen.

The extraordinary discrepancies of bodies as to their diathermancy or transparency to heat is very obvious from the following table, where the plates of the substances named are understood to have a common thickness of a tenth of an inch (accurately 0·1031 inch), and that the source of heat is an argand oil-lamp. Of 100 incident rays there passes through—

	Rays.
Rock-salt, colourless,	92
Calc spar, do.,	62
Smoked topaz, brown,	57
Carbonate of lead, colourless,	52
Plate-glass, do.,	40
White agate, colourless,	35
Glass (coloured), violet,	34
" red,	33
" green,	23
" yellow,	22
" blue,	21
Sulphuric ether, colourless,	21
Gypsum, do.,	20
Tourmaline, green,	18
Opaque glass, black,	16
Fluor spar, colourless,	15
Citric acid, do.,	15
Alcohol, do.,	15
Alum, do.,	12
Water, do.,	11
Sulphate of copper, blue,	0

It thus appears that rock-salt has the greatest diathermancy, and that of all colourless transparent bodies water

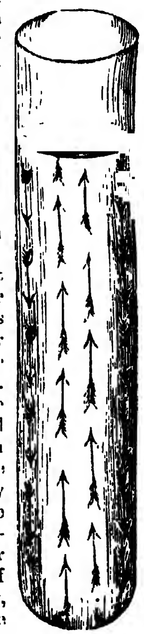
is the least diathermanous. Colourless mirror glass arrests more than one half of the heat which it receives, while transparent alum allows less heat to pass through it than the deepest coloured glasses. With the exception, however, of the black glass, all diathermanous bodies, as far as is yet known, belong to the class of transparent bodies: metals, stones, and wood, which totally obstruct the passage of light, obstruct that of heat also. It will, however, be observed that sulphate of copper, which is of a blue colour and strongly diaphanous, is perfectly athermanous.

Conduction.—The power of radiating heat is certainly the most universal mode of its propagation between different particles of matter, as well as through considerable spaces. However, it is usual, for greater simplicity, to designate the propagation through solid bodies as *conduction*. Probably heat is at once conducted and radiated through solid bodies. Whichever of these two views may be adopted, we are led to important physical distinctions between different homogeneous substances viz. their conducting powers internally and externally. Newton's formula to represent the heat communicated from one body to another of the same physical nature, when in contact, is $h\,(t-t')$; in which t and t' are the temperatures of the two bodies, and h is a constant, proportional to the interior conductibility of the particular substance. A formula for the heat lost by a body of uniform temperature when subject to a current of air is $H\,(t-T)$, T being the temperature of the air in contact, and H a constant depending on the exterior conductibility. The exterior conductibility may be very different in the same body by slight alterations in the smoothness or even colour of the surface. It is by this antagonistic principle that heat acquires a permanent state, corresponding to the different positions of the parts of bodies relative to the sources of heat and the dispersing surfaces.

The mathematical theory of the distribution of heat is founded on the principle that, when a body has arrived at a permanent state of temperature, the quantity of heat given out by any particle to the adjacent colder region must be equal to that received from the warmer particles near it, and conversely. For example, suppose a solid body to be contained by two parallel planes of indefinite extent and of uniform but different temperatures. In this case, the exterior conductibility through the sides being prevented, the temperature will be uniform in any section of the body parallel to its bases, but will increase from the lower plane in an arithmetical progression to the upper. Now, suppose a thin cylindrical rod to be placed in a medium of which the temperature is constantly zero, while its extremities are maintained at constant but different temperatures; in this case, on account of the exterior conductibility, the distribution of heat will follow, at equal distances along the rod, a geometrical progression, increasing from the colder extremity to the hott

Convection.—The propagation of heat in liquids depends very little on any communication by contact, that is, on *conduction* of heat between the particles of the liquid. If we place a heated plate on the surface of water in a vessel, but so as not to touch the edges, a thermometer placed in the water will indicate little or no alteration of temperature; we can even boil water at the top of a test-tube while a piece of ice wedged into the bottom is still unmelted. But if the bottom of a vessel of water be heated, the heat will be distributed through the liquid by currents of particles ascending from the heated part, and thus giving place to the surrounding cooler particles, which fall in and become heated, and in their turn rise—a mode of transference of heat called *convection*. The rapidity with which heat is thus conveyed is easily exhibited by means of a glass tube containing some water, as in annexed cut. Applying the flame of a lamp at the bottom of the tube, the circulation of the fluid will at once be rendered obvious by diffusing in it a small quantity of any light insoluble powder (bruised amber, for instance). The directions of the arrows in the figure point out the movements of the currents. It may further be observed that any viscosity in the liquid will impede its motion. A little gum-arabic, for instance, will considerably retard its boiling. Farinaceous substances, for this reason, allow water to boil slowly; but when such a mixture has once acquired heat, it parts with it equally slowly. A familiar illustration is afforded in the length of time porridge will keep warm after boiling. Little as is the conducting power of liquids, that of gases is probably less; but there would be great difficulty in establishing this experimentally. The effect of heat on gases is to increase proportionally their elasticity, and this disturbing force produces violent motions in their parts, so that the whole shortly acquires a uniform temperature, when other forces, such as gravity, are not taken into consideration.

These three modes of the propagation of heat—radiation, conduction, and convection—exist in our globe, and are the cause of important phenomena in the distribution of climate. First, the great mass of earth, considered in reference to its solid parts, has an external source of heat by radiation, principally from the sun, which much more than compensates the radiation from the interior of the earth. [See HEAT OF THE EARTH.] Next, the propagation of heat by motion in fluids has an immense tendency to equalize the temperatures of different latitudes; and the unequal depths of different places in the bed of the sea would, from the same cause, produce currents warmer than the adjacent water. Finally, the elasticity acquired by portions of the air in contact with the warmer regions of the globe destroys the equilibrium of that fluid, and generates winds of which the heat is communicated to the districts traversed, while the counter-currents, or cold winds, rush forward to occupy the abandoned spaces. See TRADE WINDS.



Convection.

Chemical Agency of Heat.—The agency of heat in promoting chemical action is important and extensive; in some cases no combination can take place without it, and in others it greatly facilitates chemical combination, while in some instances it decomposes compound bodies, and resolves them either into simpler or into elementary forms of matter. In the solution of salt in water, an increase of heat, by increasing the affinity between the solid and the liquid, increases the solvent power. Many gases, on the contrary, are more soluble in cold than in hot water. In the case of oxygen and hydrogen, and in many similar cases, heat has no effect on the mixture until it actually produces combination with change of state. The action of oxygen upon metals very greatly depends upon the degree of heat.

There are some gaseous compounds which can scarcely be produced by the direct action of heat on their elements; thus oxygen and nitrogen do not unite, even when strongly heated, so as to form nitrous acid or any other compound; but the heat which accompanies the electrical spark seems capable of producing this effect. There are a few cases in which heat by direct action, and without the aid of any intervening affinity, is capable of decomposing compounds.

Heat has also great power in modifying as well as in causing chemical action, and different degrees of it produce very opposite effects in some cases. If we heat mercury to about its boiling-point, exposed to the air, it becomes peroxide; but if we expose this product to a still higher

temperature than was required for its formation, it is again resolved into metallic mercury and oxygen gas.

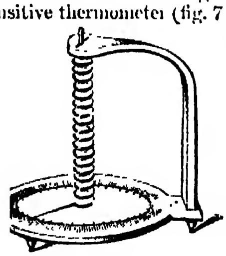
Measurement of Heat.—We measure degrees of heat by observing the expansion of solids or of liquids, usually the latter (in tubes of small bore), and such instruments properly gradnated to show the expansion caused by varying degrees of heat we call *thermometers*. To measure amounts, instead of degrees, of heat we use apparatus denominated *calorimeters*. When the temperature is so high that a common thermometer is unsuitable, a special type of instrument has to be employed, called a PYROMETER. Another mode of estimating amounts of heat is afforded by JOULE'S EQUIVALENT.

Expansion of Solids by Heat.—This occurs nearly, but not quite, proportionally to the increase of temperature, except when they are about to change their physical or chemical states. For the increase of heat without increase of temperature at these times of change see LATENT HEAT. The absorption of heat in the phenomenon of latent heat passing from a liquid to a gaseous form lies at the root of the operation of all freezing mixtures. The philosophical form of instrument is one called a *cryophorus*, invented by Dr. Wollaston, shown at fig. 14 of Plate. Two glass balls communicating by a tube inclose a small quantity of water. This is made to boil, and while the steam is issuing the open end is hermetically sealed. When one of the balls is placed in a freezing mixture, the water being in the other, the vapour is condensed, and the vacuum thus caused draws the evaporation so rapidly from the water as to produce freezing of it in the ball.

The following table gives the dilatation of a unit length of different solids from the freezing to the boiling point, and is a *mean* taken from several observers:—

Glass tube,	·00083	Copper,	·0017
Crown glass,	·00089	Brass,	·0018
Platinum,	·00093	Silver,	·0020
Palladium,	·001	Tin,	·0022
Cast iron,	·0011	Pewter,	·0023
Steel,	·0012	Grain tin,	·0025
" tempered,	·0013	Lead,	·0028
Gold,	·0015	Zinc,	·0030

If two plates of metal of differing expansibility be joined together, as in fig. 6 of the Plate, the application of heat will drive them into a curved form, the more expansible taking the outside curve. Acting on this Breguet invented a very sensitive thermometer (fig. 7 of Plate), where a spiral spring is made of two such metals throughout its length, and being mounted with an index, B, the latter revolves as the spiral twists and untwists, and marks extremely small increments of heat. The spring is fastened at the end A, and is loose at the end carrying the index. In another form of the instrument the spring is coiled in a helix, as shown in the accompanying cut.



Expansion of Solids—Solid Thermometer.

Were such a bar as that instanced above formed of two differently expansible but inflexible substances, it is obvious that it would be destroyed on the first considerable change of temperature to which it was submitted; and exactly the same result would follow, although both the parts were equally expansive, if the temperature of the one were raised higher than that of the other. This explains why glass is so apt to break when heat is applied to it. When hot water, for instance, is poured suddenly on a thick plate of that material, the upper surface is heated and expanded before the heat penetrates to the lower surface; the glass tends to bend like the compound bar, but is fractured in consequence from its want of flexibility. Every one knows how apt a tumbler is to break when hot water is poured into it suddenly while in a cold state, and that the best mode of avoiding such a catastrophe is to heat it very gradually, allowing time for the heat to thoroughly but gradually permeate the whole substance of the glass, and the whole to expand alike; it is not expansion, but *inequality of expansion* which is to be guarded against. From what has been said it will also be observed that the danger increases from the thickness of the glass; boiling water may be poured into very thin glass vessels without danger, because the heat penetrates the whole substance very rapidly, and they have moreover a slight degree of flexibility which adds to their safety. The unequal expansion and contraction of glass, on the sudden application of heat or cold, are often turned to advantage by glass-blowers. Watch-glasses are also by this property readily cut out of a globe of glass by conducting a crack in a proper direction by means of an iron rod or piece of tobacco pipe heated to redness. The chemist likewise avails himself of the same means to divide damaged globes into capsules, and indeed to convert many sorts of broken vessels into articles of experimental use.

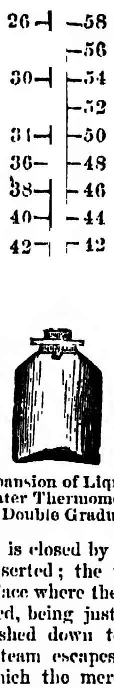
A very ingenious application of the power obtained by the enormous force of the contraction of *cooling* metals was made by Molard, to secure the Museum of Arts and Manufactures in Paris, by restoring the walls, which were giving way outward owing to the weight of the roof. His method was to insert bars of iron horizontally through the building, so as to protrude a little from the walls at each side. Heat was then applied by lamps suspended over the whole length of the bars, and the metal expanded to some extent, after which nuts were firmly screwed on the bars at both ends, and tightened to the wall as much as possible; the heat being now removed the metal began to contract, and in doing so it drew the nuts closer together, which had the effect of bringing the walls nearer to the perpendicular. By a repetition of the heating of the bars, and again tightening the nuts or plates, the bulges were entirely removed and the walls were restored to their vertical position.

Expansion of Liquids by Heat: Liquid Thermometers.—A simple means of observing the expansion of a liquid by heat is seen at fig. 1 in the Plate. A flask is filled with a liquid and held over a lamp. So soon as the temperature begins to increase, the liquid will rise above the point A. But a very remarkable exception to this regular increase of bulk with temperature occurs in the commonest of all liquids—water. Water near the freezing-point expands when the temperature is diminished, which is probably owing to the different arrangement assumed by its constituent particles preparatory to crystallization. This abnormal expansion of freezing water begins about 7 degrees above freezing-point (at 39·1°). It is easily rendered obvious by the following experiment, which may readily be performed with a phial and tube filled with pure water at the ordinary temperature (say 60°) to about the middle of the tube. Immerse the phial in a freezing mixture (pounded ice and salt), and the water will immediately begin to fall in the tube, making contraction; but in a short time an opposite movement will be perceived, indicating that dilatation is taking place notwithstanding that the cooling process is still going on.

It has been objected to the inference deduced from this experiment that the ascent of the water in the tube is referable to the contraction of the phial whereby its capacity is reduced, and not to the expansion of the liquid itself; and, in fact, this is true to a certain extent, but it is by no means sufficient to account for the whole effect. It is nevertheless curious to remark in this experiment, when accurate means are taken to estimate the temperatures of the liquid, both when heated and cooled, that it expands equally on both sides of 42°; that is, when cooled to 40° it rises to the same point in the tube as when heated to

44°, at 32° it stands at the same height as at 52°, and so on for different temperatures, as shown in the graduation on cut beneath. Cast iron, bismuth, and antimony also expand in the same manner as water in the act of cooling from the liquid to the solid state. Hence their great adaptability for casting. Such metals as gold, silver, and copper, which follow the usual law, are thereby rendered useless for casting in definite designs; for this purpose they must be stamped (not cast), as in the operations of coining.

Still the solidifying of water, cast iron, &c., are quite exceptions to the rule of increase of bulk in liquids with increase of temperature. This rule is so practically invariable that the almost universal form of thermometer is the liquid variety. *Fig.* 4 in the Plate is the tube and bulb of the common mercury-thermometer. The freezing-point is determined by immersing the thermometer in the water of melting ice, and the boiling-point by immersing it in boiling water. Fig. 5 shows an apparatus for graduating thermometers as far as concerns their boiling-point. Plunging them into boiling water would be useless, as the steam would obscure the vision. The mouth, *b b*, of the



Expansion of Liquids.
Water Thermometer
with Double Graduation.


Expansion of Gases.
Principle of the
Air Thermometer.

vessel is closed by a lid, into which the thermometers, B B, are inserted; the point M, which is known to be close to the place where the graduation of the boiling-point is to be marked, being just free of the top when the thermometer is pushed down to close above the boiling water, H H. The steam escapes at *o o*. In a thermometer the height to which the mercury swells in the tube is taken as a measure of heat, and the interval between its great height at boiling-point and that to which it sinks at freezing-point is divided into 180° in Fahrenheit's thermometer and 100° in the centigrade. The latter is now being increasingly used in England.

Expansion of Gases by Heat.—This is shown by a simple experiment figured in the Plate (fig. 2). A common phial, with a glass tube passing through the cork, has a small quantity of coloured fluid at the bottom, into which the end of the tube reaches. When heated over a lamp the air expands and forces the fluid up the tube. This and fig. 3, when properly graduated, are different forms of the air thermometer. Or, as in above cut, let a phial be about half filled with water, and let the tube just enter through the cork. Thus prepared, place the end of the tube into a vessel containing some water, so that the phial may be uppermost; pour now some hot water upon the phial, and the air in it will be so expanded as to force the water wholly out of the phial, and possibly a portion of the air itself will also escape. Allow the apparatus to remain in the same position until it cools down to its original temperature, when it will be found that the phial contains at least as much water as at first, showing that the air has returned to its original bulk.

But the investigation of the expansion of gases demands great caution. Fig. 13 in the Plate represents a common condenser gauge formed of a bent tube open at one end and closed at the other, containing some mercury. Moisten the interior of the tube with water and observe the tension; then place the instrument in warm water of known temperature, and again observe the tension; it will be seen that the depression of the mercury in the sealed end, caused by the expansion of the air, is greater than it would have been by an equal increment of temperature when filled with dry air only. Hence it appears elastic vapours mixed with air add to its elastic force, and in estimating the effect of heat on vapours we must take care they are pure, and in estimating that effect on air we must be sure it is dry. With these precautions we find that what is called the *coefficient of expansion* for gases—that is to say, the amount by which their elastic force increases with each addition of one degree of heat, as shown by their increased pressure upon the sides of the vessel containing them—is very regular. This coefficient of expansion is, for each degree centigrade, for

Hydrogen, nitrogen, and dry air, . .	0·00366
Carbonic acid gas, ...	0·00368
Sulphurous acid gas, ...	0·00?84

Those gases most easily reduced to the liquid form have, as shown in the above examples, the largest coefficient.

To put this in another way, we may suppose the gas to be raised from zero centigrade (freezing-point) to 100° centigrade (boiling-point), when our coefficient would be multiplied by 100. It thus appears that whatever pressure might be exerted by hydrogen at the freezing-point of water (0° C.), it would be increased by ·366, or considerably over one-third more, by raising it to the boiling-point of water (100° C.) If instead of increase of pressure we regard increase of volume, we get practically the same result. At a constant pressure air increases in volume by 0·00366 for every degree centigrade, and the other gases follow their previous figures equally closely. The expansion of gases may also be stated another way in an easily remembered form, as being about twenty times that of mercury. Air thermometers are consequently far more delicate than ordinary thermometers. Fig. 12 in the Plate is an air thermometer with two bulbs, measuring not the absolute heat of the room or place where it is, but only the difference of heat, if any, between the two bulbs. It is therefore called the *differential thermometer* (Leslie). A little sulphuric acid tinged with carmine suffices for its operation to be made manifest. If the two bulbs are at different temperatures the expansion of air in the warmer bulb will drive the coloured fluid down its own stem and up the opposite stem.

Maximum and Minimum Thermometers.—It is frequently necessary to determine, not the temperature of the moment, but the maximum temperature during a given period, or the minimum, or both. Fig. 8 in the Plate represents a maximum and a minimum thermometer of Rutherford's form. The upper thermometer, A, is the minimum instrument, and is filled with spirit, in which a glass index floats; this recedes with the receding spirit when it grows cold, but allows the spirit to pass it when it grows warmer. The lower instrument, B, the maximum one, is mercurial, and the end of the mercury touches a light iron needle; this is pushed up by the mercury to the

highest point, and remains there clinging to the glass when the mercury recedes. Thus the maximum and minimum of the temperature during which the instruments have been exposed are accurately marked. Such instruments form one of the most valuable appliances of the meteorologist. Fig. 9 of Plate is Six's form, and is a combination of both maximum and minimum observations in one instrument. The shaded part is of mercury, the remainder is spirit of wine—the spirit, not the mercury, is the active measure. The iron indices *a* and *b* rest on the surface of the mercury, and have a fringe of spun glass or such material to cause them to cling to the sides of the tube. They are set by a magnet held outside the tube, by which they are drawn close to the surface of the mercury. If the temperature falls the spirit contracts, and the mercury following it raises the index *a*. If the temperature rises the spirit swells, and driving the mercury before it, raises the index *b*. Fig. 10 is an apparatus for discovering the minimum temperature of liquids. A is a glass bulb terminating in a tube, B. C D is a wide tube, cemented round B by the cement filling up the shaded part, F D. Fill A B and also C D with the fluid to be measured, and then pour into C D as much mercury as will rise above B. There is a small aperture at the point B, but the mercury cannot enter it, as it is already full of the liquid. Let this be water at 40°. But if the water should presently sink to 35°, a vacuum is made in the tube B, and the mercury enters by the pinhole in sufficient quantity to fill it up. Of course the mercury falls to the bottom of the bulb at once. Such an instrument could be used for measuring the lowest temperature of lakes, wells, &c., since the mercury, when once admitted, remains at the bottom of the apparatus till it is withdrawn and measured by the graduated tube, fig. 11.

Calorimeters.—Lavoisier invented an instrument called the calorimeter for estimating the amount of heat evolved by a known weight of a substance in sinking from an observed temperature to zero. This amount varies very much for different substances, and is measured by their relation to water in this capacity. The result of the comparison is called the specific heat of the body. [See SPECIFIC HEAT.] It is figured on the Plate, fig. 15. It consists of two metallic vessels, A B C D, A′ B′ C′ D′, one contained within the other, and kept separate by small pieces of wood or glass. The space between is filled with broken ice, which, melting and constantly renewed, keeps the interior vessel at freezing-point, or 32° Fahr. Within this is another vessel, A″ B″ C″ D″, separated from the middle one by ice. Any body of higher temperature introduced into the innermost vessel will be cooled and will communicate its heat to the surrounding ice, converting a certain portion of it into water, which will show the amount evolved. The stopcocks carry off the water. That at R is the water to be measured.

Count Rumford's calorimeter (fig. 16) consists of a vessel of sheet copper, with a worm tube in the interior, making three revolutions. This tube introduces heated gas. Bodies burned at the mouth below send up their gases through the tube, and the heat communicated to the water will raise its temperature. The amount of heat can thus be measured. The lower part of fig. 17 is a small lamp used with this when ether or alcohol is to be burned. The liquid is introduced at A and burned at B, the stopper A being inserted, and the body of the lamp being buried in ice when used, as shown in the upper part of figure. The precaution is necessary because of the danger of volatilization.

The rate of cooling *in vacuo*, or in air, as in certain gases, has been the subject of much experiment, and eventually the following result was arrived at as the outcome of thousands of experiments—the velocity of cooling of a body immersed in a gas depends on the density and temperature of the gas. The ingenious apparatus used in these experiments is shown in fig. 18, where O is the bulb of a thermometer and C its stem. Fig. 19 shows the thermometer being heated in a furnace, for it is itself to be the cooling body; the screens, A′ A′ A′, serve to protect the plate, A B, from the heat. The heated thermometer is plunged into the large hollow copper ball, M M, held down in a trough of water by the beams, R R. The water may be warmed to any required temperature by vapour introduced through the tube, X U W. The plate A B, perforated at *a* and *b*, closes the ball M M, and serves also to support a cylindrical glass cap, S T, fitting round the thermometer stem. This being swiftly adjusted and the joints luted and made air-tight, the air in the ball is drawn out at once by the air-pump, of which H K is the plate, through the tube D E F. The air passes through the plate A B by the apertures *a*, *b*, then up the glass cap S T, and so into D E F. The cooling *in vacuo* is now observed. Cooling in gas is observed by letting the gas into the apparatus from the gasholder V by the pipe *m n p r s*. D F P are the necessary stopcocks. Cooling takes place generally by radiation. Experiments on the radiation of heat are made by the apparatus represented in fig. 20, and already used in this article for another purpose, which consists of two concave mirrors of polished tin some distance, say 12 feet, apart. In the focus of one is the bulb of a thermometer, and in the focus of the other a ball of hot iron. The thermometer in the focus may be compared with another elsewhere, but at the same distance from the hot ball, and it will be found to stand much higher. Fig. 21 is another instrument used for the same purpose. It is a square tin canister filled with hot water of a known heat, measured by the thermometer attached, having its four sides coated with different substances, so that their respectively different powers of radiation may be readily measured. The powers of different surfaces for radiating heat differ in a most extraordinary degree. See RADIATION.

Convertibility of Heat into other Forces of Nature.—The conversion of heat into light, into electricity, &c., and *vice versâ*, is one of the latest discoveries of science. The most recent are the researches of Tyndall into the conversion of heat into sound. Under certain circumstances of pressure, &c., gas flames will readily sing to the note of a tube held over them, and an instrument able to play simple tunes has even been constructed. [See SINGING FLAMES.] Later still, in 1881, Tyndall showed how heat (radiant heat) thrown in an intermittent beam upon certain gases produced sound as the gas swelled under the beam and shrank in its absence, thus setting up a vigorous pulsation, and consequently emitting a musical sound.

In 1880 Professor Graham Bell had shown at the Royal Institution that certain solid substances, when touched by a luminous beam, gave out musical sounds. This effect was at first attributed to the luminous rays of the spectrum; but Professor Tyndall's experience led him to refer it to the "intermittent absorption of radiant heat." At that time he was experimenting on vapours, and substituting in idea gaseous for solid matter, he clearly pictured the sudden expansion of an absorbent gas or vapour at every stroke of the calorific beam, and its contraction when the beam was intercepted. Pulses far stronger than those obtainable from solid matter would probably be thus produced, which, when rapid enough, would generate musical sounds. The intensity of the sound would, of course, be determined by the absorptive power of the gas or vapour. The idea was tested with eminently conclusive results. Sulphuric ether placed in a test tube, and exposed to the intermittent beam, sent forth a feeble musical sound; formic ether behaved in the same way. But with a modification of the apparatus, and lime-light as a source of heat, sounds of surprising intensity were produced by all the highly absorbent gases and vapours. Among gases chloride of methyl was loudest. Conveyed directly to the ear by a tube of india-rubber, the sound of this gas seemed as loud as the peal of an organ. Tyndall has tested more than

eighty vapours for their sound-producing power, and finds that sulphuric ether stands highest. Among the best of the later treatises on heat is that by Professor Tait (London, 1884), which is at once popular and exhaustive.

HEAT, ANIMAL. The conversion of the food of man and the higher animals into nutriment for the body is attended with changes which produce an evolution of heat that constantly maintains the temperature of an animal at a point above or below, according to circumstances, the temperature of the medium in which it exists. The degree of heat possessed by animals not gifted with the power of locomotion is very little above that of surrounding media, and in this respect resembles the heat given off by plants. In proportion as animals possess the power of locomotion they evolve heat from their bodies. This arises from the fact that where the muscular system is most exercised there is greatest demand made upon the nutritive processes going on in the system. We should therefore expect to find that the quantity of heat developed in the invertebrate animals was less than that in the vertebrate class. This fact has been recorded by many observers, as, for instance, by John Hunter in the "Annelida," and by Newport in "Insects."

Among the vertebrate animals fishes and reptiles have the lowest temperature. Fishes have a temperature of about 7° above the surrounding medium.

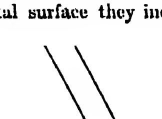
In man the temperature of the accessible parts of the body, as the mouth, axilla, &c., is usually between 97·7° and 98·6°. The human blood is found to have a temperature in health varying from 100·6° to 101·75°; in disease it rises to 106° or 109°; in typhus it rises to 106°; in Asiatic cholera it falls to 77°. In healthy persons the temperature attains its maximum during the day, and falls from 1·8° to 2·7° during sleep. Most of the mammalia have a higher temperature than man (the average is 101°), and birds develop a greater quantity of heat than any other class of animals (the average being 107°). This arises from the nutritive changes going on in the bird in order to support the enormous muscular power which it is compelled to exert during flight.

There is now no question that the cause of animal heat is the chemical changes which are going on in the nutrient fluid of the body. During the act of respiration a large quantity of oxygen gas is taken into the lungs, which is absorbed by the blood and carried to the tissues. Here it meets the various compounds of carbon and hydrogen which result from the wear and tear of the tissues; and the consequence is a union of the oxygen with the carbon, and the formation of carbonic acid gas, which gas is given out when the blood again reaches the lungs during expiration. When carbon and oxygen unite out of the body heat is the result, and the same thing occurs when they unite in the body; and it is through the medium of this change that the bodies of animals are raised to a given temperature by the circulation of the blood through the system. It has been calculated that there is more oxygen absorbed than is given out of the system in the form of carbonic acid gas; it is probable that this enters into combination with hydrogen and compounds of hydrogen, nitrogen, and carbon, and thus contributes to the raising of the animal heat. The main sources of this heat are the muscles, the great secreting glands, and the brain. The loss of heat is chiefly from the skin; a little is also lost by the air passages.

This theory of animal heat explains many well-known phenomena; as, for instance, the slight independent warmth of the fœtus, and of those young animals which are born in an imperfectly developed condition. The low temperature of persons who are afflicted with *morbus cæruleus*, where the blood is only imperfectly oxygenated, and the cold experienced by aged and debilitated persons, as also the increased temperature observed in persons labouring under attacks of inflammatory disease, are confirmatory facts. The phenomena exhibited by the *hibernation*, or partly suspended vitality during winter, of some animals are explained by this theory.

HEAT OF THE EARTH. This arises from two sources, the earth's own proper heat and the solar heat shed upon the earth's surface. Of these the latter is of infinitely the greater power at the earth's surface. It affects the earth somewhat unequally, though in itself constant, because of the motions of the earth and of the varied character of its surface. As regards the first the interval from spring to autumn is 184 days, and from autumn to spring 181 only. We should therefore say that the northern hemisphere would receive more heat than the southern, since it has three days more summer; but against this is the fact that the earth is much nearer the sun, in its orbit, in our winter than in our summer, and consequently the Australian summer, though three days shorter, is much hotter than our own. Indeed, the amount of heat received by the earth when nearest the sun (perihelion) is to that received when further from the sun (aphelion) as 103 to 96. As to the second cause of inequality, the varied condition of the earth's surface, the earth has about one-fifth land surface and four-fifths water surface, and the former lies in such masses that a land hemisphere and a water hemisphere may be formed by dividing the globe in a proper manner. But water has a much higher specific heat and lower radiating power than land, and therefore the presence or absence of the sun's rays produces much less effect on the surface temperature of the oceans than of the continents. It is easy to see the effect of this when we consider that there is more than three times as much land in the northern as in the southern hemisphere, even taking the hemispheres as they stand, divided by the equator.

Further, the effect of the solar heat is not greatest when that heat is greatest—that is, when the sun is most nearly vertical over the place whose temperature is under consideration. Much must be allowed for the accumulative power of the continued supply of heat. Thus though the sun's heat increases from dawn to noon and then decreases to sunset, when it ceases, the day is hottest not at noon, but at 2 p.m., and the night is coldest not at midnight, but just before dawn. So also although the sun is most vertical at midsummer, the earth is hottest in July, not June; and although December is the midwinter month, January is the coldest. It may be asked why the sun's heat is less when less vertical—why, for instance, the rays are so mild at noon in winter and so scorching in summer? To this the reply is that the rays have to pass through a greater thickness of the earth's atmosphere when they are further removed from the vertical position, as in winter, when the sun's path is low in the heavens, and thus they lose much of their force. (Experiments show that the vertical rays lose 20 per cent. of their heat by the cooling action of the atmosphere, and horizontal rays lose almost all their heat.) Also since the rays fall obliquely they are spread over a much greater surface than when they fall vertically, consequently each part of that surface is less warmed. Thus though the oblique lines at *a* are only as far from one another as the vertical lines at *b*, yet when they meet a horizontal surface they inclose a very much larger space.



Add to this the weakening of the force by the greater thickness of the atmosphere penetrated in the oblique path, as explained above.

The distribution of solar heat over the earth is therefore much varied, and by no means coincides with or has the faintest relation to the parallels of latitude. Alexander

von Humboldt suggested that the *isothermals* or lines of equal heat should be drawn upon maps of the globe, each isotherm passing through places whose mean annual temperature was alike, regardless of differences of latitude. Dove worked this out for the British Association in 1853. The resulting curves are very remarkable and suggestive. See ISOTHERMALS.

The coldest inhabited places on the earth are in the extreme north of Siberia in December and January, but taking the year round the extremest northerly stations in North America are colder. At Werchojansk in Siberia, the coldest place known in winter (the thermometer sinking to 56° *below zero* on the average, with exceptional plunges down much lower, once even as low as 81° below zero), the summer heat has been known to rise to 96°; but at Dr. Kane's winter station at Rensselaer Harbour, North America, it never rose above 55 usually even in July close to the freezing-point. The warmest of inhabited places is Massowah, the May average for which is 99°; but individual temperatures rise of course much higher, especially in sandy deserts. Thus Sir John Herschel observed a temperature of 159° at the Cape, and Sturt when on the Macquarie River in New South Wales declared that the ground was "almost molten, and if a match fell on it, it immediately ignited." A thermometer at Cooper's Creek in Australia, graduated up to 127°, which was left out exposed to the sun, was burst by the expansion of the mercury, which had been raised far beyond that heat.

The earth's own internal heat is a much less important source of warmth to the surface. It is supposed that the earth was originally liquid and viscous (possibly a glowing nebula before that), and if this is the case it is certain that it has contracted at least 189 miles in diameter in cooling, emitting in so doing a force which geologists claim to account for all the inequalities of the earth's surface. At 30 miles deep, judging by the rapid increase in heat as we descend in mines after passing below the surface-effects of solar heat, all known substances would be molten. The enormous pressure would yet keep the mass solid, pressure driving up the melting-point; and since we know that as a whole the earth is as rigid as steel, though the outer surface is far less rigid, the core of the earth must be of correspondingly greater density notwithstanding its presumed great heat. There is a point beneath the surface at which the variations of solar temperature cease, and this is called the "layer of constant annual temperature;" it is about 30 yards below the surface at Paris, and the temperature is 53° Fahr. From this it gains about 1° for every 50 feet or so of descent, but this varies considerably in different places. At Irkutsk in Siberia the increas s 1° for 12 feet of depth, whereas at Mansfield it is o 1° for 175 feet. The radiation of the earth into space nce so rapid and so tremendous in its effects, is now very much diminished by the solidity of its ast, but it is yet incessant. Experiments make it tolerably certain that the surface of the earth is constantly warmed from within by one-seventieth of a degree, which it as constantly radiates into space.

HEAT SPECTRUM. Every light, whether sunlight or not, is accompanied as it issues from its light-source by considerable heat. But when a beam of the light is refracted by a prism so as to form a SPECTRUM, it is found that the heat contained in the various wave lengths, which manifest themselves by the different colours of the spectrum, follow quite a different law to the light. In fact, the heat spectrum of a beam of light is quite another matter from the light spectrum. Though it is invisible yet we can trace it by its effects; and as early as 1776 the Abbé Rochon carried out a series of experiments which gave him as their result that the heat rays of the red were eight times as powerful as those of the violet. Leslie in 1798 got more precise relationships, and found the relative heating powers of the blue, green, yellow, and red rays, to be 1, 4, 9, and 16, a suspiciously alluring series (1^2, 2^2, 3^2, 4^2). So successive investigations went on until Tyndall mapped out the heat spectrum by means of a curve, examining the electric light as the light-source, and using the highly diathermanous rock-crystal for the lens and prism instead of the comparatively absorbent glass. The measurements were made by a Melloni's thermopile of great sensitiveness. Taking the maximum intensity of heat as 100, Tyndall found the heat of the violet and blue rays in the spectrum to be 0; the green rays yielded 2, and the red gave a rapid rise to 21, and then on to 45, where the visible spectrum ceased; but passing into the dark region *beyond* the spectrum the heat rose to 100 in a steeply ascending curve, and then even more steeply descended to 2. As Tyndall puts it, the curve "shoots up, just beyond and massive peak, a kind of Matterhorn of heat, which quite dwarfs by its magnitude the portion of the diagram representing the visible radiation." This curve is less steep for sunlight, on account of the aqueous vapour of the atmosphere absorbing much of the "dark rays." With sunlight the heat of the obscure rays is only twice that of the visible spectrum, but with the electric light it is eight times as much.

HEATH, HEATHER (Erica), one of the most extensive and beautiful genera known in the vegetable kingdom, belonging to the order ERICACEÆ.

The genus includes a great variety of species which possess much diversity of colour and beauty in their flowers. Lovely as even our wild moorland heaths are, they rank among the lowest in point of beauty in this extraordinary genus, in which all the hues of red, pink, and purple vie with each other in the most brilliant manner, assuming every tint but blue, and fading into the purest and most transparent white. The forms and sizes of the corolla are as varied as the colours, and are so exquisitely beautiful and delicate as to render description useless.

The genus is confined to the Old World. A few species occur in the north of Europe, and others in the countries bordering on the Mediterranean. In Great Britain the Common Heath or Ling (*Calluna vulgaris*) covers large tracts of waste land, and is used to thatch houses, to make brooms, and even beds in the northern parts of the island. It is the only species in the genus. It is a low-tufted shrub, with small, sessile, closely imbricated leaves. The colour of the flowers varies from a deep red to a white, and numerous varieties have been named. There is a double variety, which is extremely beautiful. All our British heaths are improved by cultivation, and are general favourites. They will not, however, thrive in hot dry places and in any common soil, but require sandy peat earth and a situation where they are moderately shaded from the sun. *Erica carnea*, one of the few plants whose flowers bid defiance to the rigour of winter, and appear as the earliest harbingers of spring, is found wild in Germany and generally on the mountains of middle Europe. The flowers are flesh-coloured, and do not last longer than the beginning of April; but the plant forms a good edging in gardens. *Erica australis*, *arborea*, *mediterranea*, and *polytrichifolia*, adorn the rocks of the south of Europe. *Erica mediterranea* is also found in Ireland. The flowers are pale red, with prominent anthers.

But it is at the Cape of Good Hope that the principal part of the species is found, indeed the whole of those which cultivated in greenhouses. In their native country they are by no means so handsome as when cultivated, but form scraggy shrubby bushes, with little beauty.

Those who have not the convenience of a greenhouse or heath-house to grow Cape heaths in, may nevertheless form beautiful clumps in their flower gardens by a judicious selection of hardy sorts, removing the soil where it is not suitable for their growth, and filling the place with a mixture

of peat soil and sand, and at the same time introducing a quantity of freestone to equalize the moisture of the soil. There are about 400 species in the genus Erica. The chief characteristics are the following:—The calyx is four-parted; the corolla is bell-shaped, four-toothed, persisting after it has faded; the fruit is a four-celled capsule with valves opening between the dissepiments, and carrying a part with them. In Calluna the four-parted calyx is longer than the corolla, and the valves open at the dissepiments and separate from them.

HEATH-COCK. See BLACK-COCK.

HEATHEN, an old English word which is now used as a general term for those who disbelieve the Christian religion. The meaning was originally *heath-men*, *i.e.*, dwellers in the open country, exactly the meaning of the Latin term *pagan*. Pagans or heathens, then, were those who by dwelling far away from towns were remote from the new religious teachings, and still continued the ignorant and superstitious practices of their forefathers. The German word *heiden* (from *heide*, a heath) is synonymous with our *heathen*.

In the Bible (both Old and New Testaments) the words translated by *heathen* mean, of course, those who disbelieve the Jewish religion; and in its later usage *heathen* is held to include even the Samaritans or heretical Jews. Nothing was more unexpected in the teaching of Jesus than his hearty acceptance of the heathen as converts. He frequently asserts that the heathen are surpassing the Jews, that luxurious Tyre and Sidon and licentious Sodom shall fare better in the final judgment than the Jewish Bethsaida, Chorazin, and Capernaum. He declares Jewish ceremonials unessential to salvation, thus "breaking down the barrier between the peoples." It is to Jesus, therefore, that we first owe the cardinal alteration from the old to the new meaning of the word *heathen*. But though heathens, after this teaching of Jesus, gradually came to be held as non-Christians and not as non-Jews, the Jews have never been themselves considered as heathen, however bitter and even contemptuous they may have been in their rejection of Christianity.

Consequently, after the death of Jesus, those who followed his teachings gradually found themselves dividing into two camps, the Jewish-Christians and the heathen-Christians, *i.e.* those who had been converted from Jewry and from heathendom respectively. The first made a claim upon all heathen-Christians that they should become Jews; they sought indeed to confine the term heathen to its original significance, and to reduce Christianity to a mere reform of Judaism, leaving all its exclusiveness and most of its wearisome ceremonial still untouched. It is to St. Paul that the victory of the larger view is due, and the Jewish party so warmly resented his advocacy of what has become the universal Christian position in the matter, that they actually worked against him, and were thus (though they little supposed they would produce such an effect) the means of blessing the world for ever by calling forth the wonderful series of Pauline letters or epistles to the congregations whom it was sought to win away from his influence. The career of the apostle to the Gentiles is dealt with elsewhere [see PAUL, ST.]; but it must not be forgotten that though the better Jewish Christians became reconciled to the Pauline view, we can read between the lines that the bulk of that party ceaselessly pursued him with bitter hatred. The end of the long controversy was brought about partly by the taking of Jerusalem by Titus, A.D. 70, and the consequent destruction of the centre of Jewish ceremonial, and partly by the growth of a middle party desirous of reverencing both Peter and Paul alike. The catholic (*i.e.* universal) church was the outgrowth of this party; and those Christians who took the ultra-Jewish and anti-Pauline view of Christianity fell away on the one side as EBIONITES, while those who took the extreme heathen or Gentile view, rejecting the law and the teaching of the earlier apostles, fell away on the other as MARCIONITES. Since then the world, from the Christian point of view, is divided into those of the true faith, heretics or backsliders from the true faith, and heathen or those ignorant altogether of the true faith, the Jews forming a separate division. The mediæval phrase "Jews and heathens" shows the distinction universally drawn between them. On the other hand, so capricious is the people in its use of words, that Mohammedans, who do believe in Jesus and accept a large part of the teachings of both Judaism and Christianity, are held (or, at any rate, were in mediæval times held) to be the typical heathen of all heathen.

HEAVE is a miner's term used to describe the horizontal displacement of an outcrop produced by a fault. The heave may occur to a bed, mineral vein, or fault. No horizontal motion is necessary, however, and in the majority of cases the horizontal displacement of the outcrop is the result of a vertical movement on one or both sides of the break. If the outcrop be that of a vertical bed or vein there will be no displacement at the surface without a horizontal movement; but if it be that of an inclined bed or vein the amount of heave will vary according to the amount of vertical movement and the inclination of the bed. Although vertical movement is the rule, a horizontal movement in some cases is quite possible. With inclined beds and veins the shift on the upthrow side always takes place in the direction of the dip. Miners distinguish between right and left hand heaves, according as the throw is to the right or left hand viewed from a position on the outcrop and looking towards the break. Right-hand heaves have a predominance in most mining districts.

HEAVEN, a term used in popular language to designate the expanse surrounding the earth, which appears to the eye like an immense arch or vault, in which are seen the clouds and the sun, moon, and stars. In theology it refers to the scene, or place, or condition of eternal life; to that portion of infinite space in which the all-present God is believed to afford a special manifestation of his presence. In the Authorized Version the word represents four distinct Hebrew terms, viz.—(1) *Shâmayim*, literally height, as in the first verse of the book of Genesis: "In the beginning God created the heaven and the earth;" (2) *Râki'a*, a solid expanse over the earth, as in Gen. i. 6: "firmament;" (3) *Marom*, literally a mountain or high place, as in Isa. xxiv. 18: "on high;" and (4) *Shechâkim*, literally that which is beaten out, as in Job xxxv. 5: "heavens."

In the Old Testament generally three regions are distinguished as belonging to heaven; the first of these and the lowest being that of the winds and the clouds, the second the supposed solid crystal sphere of the firmament and the place of the heavenly bodies, and the third and highest the abode of Jehovah and his angels. In the well-known vision of Jacob, that patriarch is described as seeing a ladder extending from this highest heaven to the earth, forming a pathway for the angels, and also apparently through the opening at the top as seeing a vision of Jehovah. In the account of the destruction of the earth by the flood the waters are spoken of as coming through "the windows of heaven," a phrase that is repeated several times in the Old Testament. The later rabbinical writers, improving upon the more primitive conceptions, divided heaven into seven regions, counting the space between the clouds and the earth as the first, the second the place of the clouds and stars, the third the abode of the lowest grade of angelic beings, the fourth, fifth, and sixth as the homes of angels of higher grades, the seventh, however, being the abode of Jehovah and the highest rank of the angels.

In the New Testament the term heaven is generally used to designate a place where God is specially manifest, Christ sitting at his right hand, and where the angels dwell in

happiness. The oft-repeated phrase, "kingdom of heaven," however, generally means the reign of the Christ upon earth, expected by the Jews in a literal and material sense, the pious dead (*i.e.* saints) being privileged to rise again in bodily form to meet their Lord returned to earth, and to share his reign. The belief in this second coming of Jesus and the saints was practically universal for long after the crucifixion, yet we can hardly conceive that as used by Jesus and the apostles the phrase "kingdom of heaven" did not also refer to a spiritual reign over the hearts of men. In the days of the early church, subsequent to the apostolic period, the threefold division of heaven was accepted by some of the fathers, while others refer to the seven heavens as conceived by the rabbinical writers. The nine heavens of mediæval belief, a threefold division of the threefold division (the number three being the most sacred number), for ever crystallized and made tangible to us by Dante's immortal epic, were formulated with precision by DIONYSIUS AREOPAGITICA, and will be found enumerated and fully described in the article under that heading. It was also believed that admission to the abode of bliss was first granted to the saints on the ascension of Jesus Christ the Redeemer. Previous to this event the spirits of good men had remained in a temporary abode, the *Limbus Patrum*, but being delivered by the power of Christ they ascended with him to Paradise. To this happy abode it was believed the spirits of all those who had been saved from sin would be admitted immediately after death, but the full attainment of happiness would be reserved until after the resurrection and the final judgment. One theory, to the effect that the soul after death remains in a state of unconsciousness until the day of the resurrection, has always found a few adherents, but it has never obtained general acceptance in the church.

It has often been observed that, although the fact of a future life and of a heavenly home for the just underlies the whole of the teaching in the New Testament, yet details as to the condition of that life are very sparingly given, and of these the majority are found in the Apocalypse of St. John. The hope of heaven has from the first formed one of the most powerful of the motives presented by Christianity, and its poets, mystics, apologists, and theologians have in their different ways sought to expound and illustrate this theme. By many of the more thoughtful, speculation as to details of the heavenly life has been discouraged as irreverent, seeing that it must transcend not only all human expression, but also the highest human thought, based as the latter must inevitably be on analogy from the circumstances of the life upon earth. But at the same time the express promises of the rest from sin, sorrow, bereavement, and uncertainty, which are given in connection with it, have ever been cherished by Christians as sources of comfort and consolation.

The belief in a heaven of heavens is found to form part of most of the great religious systems of the world. By the ancient Greeks none were supposed to be admitted to the heaven of the gods with the exception of a few deified heroes; and according to the Homeric poems the shades which formed the abode of departed spirits were far inferior as a dwelling-place to the earth itself. [See HADES. HELL.] The description of the under world given by Virgil is of a more cheerful character, and the home of the brave and just is described as a place of happiness and rest. The Mohammedans have adopted the notion of seven heavens rising one above the other, according to degrees of dignity and glory, but the happiness of the Mohammedan paradise is generally supposed to consist in sensual enjoyment. Each race has formed for itself its own ideal of enjoyment, and transferring this to the future state, has imagined its realization to constitute the happiness of heaven. The etymology of the word *heaven* is not known. It is the Old English *heofon*, and cannot as yet be traced further.

HEAVY SPAR is a name often used for barytes on account of its great weight. It is composed of sulphate of baryta ($BaSO_4$), giving the barium colouration in the Bunsen flame, and sulphur reaction when fused with carbonate of soda and moistened on a silver coin. It crystallizes in tabular rhombic prisms, and has a specific gravity of 4·5. These three characters—its blowpipe reactions, crystalline form, and great weight—are usually sufficient to determine its identity. When massive and cryptocrystalline it is often known as *cawk*. It occurs mostly as a GANGUE, especially with lead ores, but sometimes as a separate lode, and is used chiefly as a pigment or for the adulteration of white lead, while it has also a limited application in pyrotechnics and in the manufacture of luminous paint.

HE'BE, in Greek mythology, the Goddess of Eternal Youth and the cupbearer of Olympus, a daughter of Zeus and Hera, who gave her as a wife to Herakles in reward for his achievements, and to celebrate her reconciliation with him on his becoming a god. When Ganymedes became the cupbearer of Zeus he shared the office with Hebe. The nectar which they poured was that which kept the gods for ever fresh and young.

HEBER, REGINALD, second bishop of Calcutta, was born 21st April, 1783, at Malpas in Cheshire, of which place his father was for many years co-rector. He entered at Brasenose College, Oxford, in 1800, and in his first year at the university he gained the prize for Latin verse. In the spring of 1803 he wrote his prize poem "Palestine," which has obtained a permanent place in English literature. In 1804 he became a fellow of All Souls, and in 1807, before he had obtained his degree of M.A., he took orders, and was instituted by his brother Richard to the family living of Hodnet. In April, 1809, he married Amelia, youngest daughter of Dr. Shipley, dean of St. Asaph. While discharging the duties of his parish with much earnestness, he was ardently attached to the pursuits of literature He was a frequent contributor to the *Quarterly Review* from its commencement. In 1812 he published a small volume of "Poems and Translations for Weekly Church Service." The composition of his "Hymns," with a view of improving the psalmody and devotional poetry used in churches, was also a favourite recreation. His political views were those of the High Church and Tory party, but devoid of all bitterness. In 1815 he was appointed Bampton lecturer, and the subject he selected was "The Personality and Office of the Christian Comforter." In 1817 Dr. Luxmore, the bishop of St. Asaph, appointed Heber to a stall in that cathedral. In 1819 he edited the works of Bishop Jeremy Taylor. His other works consist of "Parish Sermons," preached at Hodnet, and sermons preached in India. In April, 1822, he was elected preacher of Lincoln's Inn. At the end of that year his friend and connection, the Right Hon. Charles W. Williams Wynn, who was at the time president of the Board of Control, offered him the vacant see of Calcutta, which he accepted after two refusals. He embarked for his diocese 16th June, 1823, and on the 15th of June, 1824, began his visitation. The journal which he kept during his visitation, and which was published in three octavo volumes, shows the extent of his observations. On the 3rd of April, 1826, after investigating the state of the mission at Trichinopoli, he retired to use a cold bath, in which he was found dead about half an hour afterwards. His life was published by his widow, in two volumes (London, 1830).

HÉBERT, JACQUES RÉNÉ, known as *Père Duchesne*, from the name of his journal ("the brutalest newspaper yet published on earth," as Carlyle calls it in his splendid prose epic), was born in 1715 at Alençon. He went as a lad to Paris, turned actor, thief, valet, newspaper fire-brand editor, and what not. When the

Revolution began he stole the title of a paper, *Le Père Duchesne*, which was attempting to educate the people into the constitutional use of their new liberties, and had some popularity. The sham *Père Duchesne* soon eclipsed the real one, its vile scurrility hitting the fiery passions of the mob and inciting them to ever-increasing violence. That the Revolution escaped from the hands of honest men and ran riot to its fearful and bloody end is largely due to this terrible monster in human shape. He rose quickly into popular favour, and was made *procureur-substitut*, in solemn mockery of law, and sat as magistrate of the people in the Paris town-hall. The Girondists knew his real character, and in their last all-too-feeble attempts to stem the torrent when it was already dashing over the precipice, they arrested Hébert, 30th May, 1793, and flung him from the judgment seat into prison.

On the 2nd of June Paris had risen in rebellion, and the Girondists themselves were in prison, never to leave it save for the bar and the scaffold; and Hébert was more the darling than ever of the lowest strata of the fierce mob who now held men's lives in their hands. His abominable and unnatural insults against the poor queen when upon her trial can never be forgotten nor forgiven. When a juryman asked her why Hébert's accusation was not answered, she exclaimed with noble emotion, "Because nature refuses to answer such a charge brought against a mother. I appeal to all the mothers that are here." Robespierre, even, was horrified and disgusted. Amid so much that is noble, if so fearfully mistaken, in that period of agony called the Reign of Terror, this wretch alone appears in unmitigated blackness, possibly the vilest man on earth. It was he who on 28th October, 1793, brought eternal disgrace upon the Revolutionaries by forcing them to agree to his law for shutting the mouths of prisoners when the tribunal was satisfied, in order to quicken the supply of victims to the guillotine.

At last Hébert, in a violent speech at the Cordeliers Club, threatening a new insurrection on some discontent with the ruling faction, brought down the heavy hand of Robespierre upon him. He was arrested 15th March, 1794, and thrown into the Luxembourg with all his following, now somewhat numerous. His frantic ravings had risen to such a pitch that he and his *enragés*, as they were termed, were suspected of being bribed by Pitt and the English to overforce the Revolution, and through the sheer disgust of mankind to pave the way for the return of the Bourbons. It was easy enough to prove the frenzy, and everyone believed without proof in the "gold of Pitt;" the whole detestable crew of Hébertists were therefore, after the briefest trial, guillotined *en masse* nine days after their arrest. Hébert himself went to death ignobly, his head sunk on his breast in abject terror.

HEBREW LANGUAGE AND LITERATURE. 1. The name Hebrew language commonly denotes the language of the books of the Old Testament, the remains of the national and sacred literature of the ancient Israelites. This name does not, however, occur in the Old Testament, where we meet with the designations "language of Canaan" (Isa. xix. 18) and "Jewish" (2 Kings xviii. 26; Neh. xiii. 24). The term Hebrew is the English representative of the ancient *'Ibhri*, derived from the word *'Ebher*, from the root *'abhar*. Its meaning cannot be said to be satisfactorily settled. According to the genealogical tables in which later writers expressed their ideas about the origin of their nation (Gen. x., xi.), 'Ebher was the great grandson of Shem; but it is now almost universally recognized that these lists do not deal with persons at all, but were designed to indicate the supposed affinities of races and peoples, and, in the case of the Hebrews in particular, the stages of national migrations. The meaning of the term Hebrew must therefore be sought from the root, which signifies to "cross over," or also, as some have suggested, to "wander round." It would thus denote the "men who had crossed over," the "men from the other side" (viz. of the Euphrates, whence the immigrant Israelites made their way into Canaan), or, again, the "wanderers" or nomads. When applied to language, it was employed in later times to denote the language of the Jews as distinguished from that of the Greeks; and among the early Christians it became fixed to the language of those Jewish records which alone they considered important—viz. the sacred writings of the Old Testament.

2. Comparative philology has long since demonstrated that Hebrew belongs to the Semitic group of languages. These languages are spread over a large geographical area, extending from the highlands of Armenia in the north to Arabia and Ethiopia in the south, from the Mediterranean on the west to the valley of the Euphrates and the Tigris on the east. They include (1) the Aramean in the north; (2) the old Babylonian and Assyrian of the cuneiform inscriptions in the east; (3) the languages of Canaan, among which are to be reckoned Hebrew and Phœnician, in the middle; and (4) Arabic and Ethiopic in the south. The oldest literary remains belong to the great Mesopotamian cities; the last to reach a great literary development was Arabic. A comparison of the various forms of these languages proves that they are rather to be regarded as different members of one family, like the Teutonic or the Slavic tongues, than as different families under a higher order, such as the Indo-Germanic. The possession of common roots, the triliteral character of these roots, the method of derivation by internal modification with only a very small number of preformatives and afformatives, the absence of compounds, the existence of only two genders, the extreme paucity of particles for grammatical subordination, the want of definite tenses in the verb, the employment of pronominal suffixes added to verbs and nouns, these are among the peculiarities connecting Hebrew with its kindred languages, which are indeed almost like dialects of the same parent stem. The remains of Hebrew literature in the Old Testament show us also a very small number of foreign words, derived from Egyptian, Indian, and Persian sources, but no connection can be established through these with either the Indo-Germanic or the North African languages. And though a number of Hebrew roots show striking resemblances to some Sanskrit and other related forms, no sufficient evidence has yet been produced of any close original relationship between the Semitic and the Aryan families.

3. The earliest monuments of Hebrew and the provincial dialects of Canaan are the Siloam inscription discovered in 1880, and the Moabite stone found in 1868. The first is in the purest Hebrew, and though its date cannot be determined with certainty, yet its place between the tenth and sixth centuries B.C. establishes it as a contemporary witness of the Hebrew of the monarchy. The Moabite stone can be fixed to the ninth century B.C. Both these records show a remarkable correspondence with the literary style of the Old Testament books preceding the exile, and imply the familiar use of the art of writing. That the Canaanites possessed this art before the immigration of the Israelites has been plausibly inferred from the name Kiryath-sepher, "book-city," the ancient name of Debir (Josh. xv. 15, 16; Judg. i. 11, 12).

4. There are, however, no means of tracing with certainty the stages by which writing became the common vehicle of literary expression among the Hebrews. The Jews, of course, had their own traditions on the subject, some of which are found recorded in their great storehouse of national lore, the Talmud. Of the origin of these traditions we are really ignorant. The circumstances of the first composition of their sacred books are altogether unknown to us from any other source than the books themselves. We find no quotations from them written on

monuments which might fix for us indisputable dates. We can only compare the Jewish tradition, much of which was adopted by the Christian Church, with the phenomena presented by the writings to which it refers, and see whether the conclusions to which these phenomena point confirm or discredit the traditional view. It must be remembered that the earliest evidences which we have concerning the belief of the Jews on this subject cannot carry us back much before the birth of Christ; and this era is, in many instances, separated by a very wide interval—perhaps of several centuries—from the origin of the books themselves. Many other circumstances must also be taken into account in determining what weight is to be assigned to the traditional conceptions which long passed unchallenged. The first serious criticisms on these conceptions (passing over a few objections propounded by some heretical and philosophical opponents of early Christianity) proceeded from a great mediæval Jewish scholar, Abn Ezra. After the Reformation attention was awakened, and in the seventeenth century the theory of the Mosaic authorship of the whole Pentateuch was shaken by the observations of the Anglican Hobbes, the Jewish Spinoza, and the Catholic Father Simon (of the Oratory in Paris). The discovery of the existence of different documents in the Book of Genesis, distinguishable by different names for the Deity—a discovery due to the Belgian physician Astruc in the last century—put an important key into the hands of scholars. A long series of laborious investigations, conducted by successive generations of students, has brought to light immense numbers of new facts, which have in many cases largely modified, in others completely revolutionized, the old traditional view. The principal discussions have ranged round the Pentateuch, the Books of Isaiah and Daniel, and the Psalms. The chief inquiries have been pursued by German scholars like Eichhorn, De Wette, Gesenius, and Ewald. The way opened by them has been trodden by many successors. The leaders of Old Testament investigation abroad, Dr. Reuss of Strasburg, Dr. Kuenen of Leyden, Dr. Wellhausen, and others, have now established a school of opinion which is every day winning new adherents. In France their chief conclusions with respect to the Pentateuch, for example, were frankly accepted by the great Catholic scholar M. François Lenormant, who remarked that the Roman Catholic Church guaranteed the *inspiration*, but imposed no belief as to the *authorship* of the books of the Old Testament. In this country they are in the main earnestly advocated by some of the foremost Hebraists and critics.

5. It was formerly supposed that the first five books of the Old Testament, commonly called the Books of Moses, were the first great monument of Hebrew literature. It is now, however, generally recognized that they do not themselves claim to have been written by him, or by any other single author. And the tendency of inquiry has been to show that they are, on the other hand, composed of materials of very different ages. In their present form they exhibit the growth of many centuries, and are the issue of successive editorial revisions. The prophetic tradition, however, which ascribed to Moses the beginning of what afterwards grew into a great collection of laws, is doubtless well founded. The earliest laws were issued in the shape of specific judicial decisions ("judgments," Exod. xxi. 1), by which the tribal customs were gradually consolidated, under the new religious influence inspired by Moses, into a sacred code. These "judgments" were handed down from father to son at the local sanctuaries where justice was administered. The earliest collection of them, which may be designated the First or Short Code, is contained in Exod. xxi.-xxiii. As it assumes everywhere the existence of settled agricultural communities in the land of Canaan, it is clear that it did not come into existence in its present form until after the conquest.

6. Besides sacred law, however, there early arose another kind of composition, destined to develop into a second important branch of literature—viz. the national songs. Some of these were of extreme antiquity, and had perhaps lingered in the memory of the people—sung beside the watch-fire in the night-camp or by the village well (Judg. v. 11)—long after all knowledge of their first meaning had disappeared (*e.g.* Gen. iv. 23, 24). Others were connected with incidents of the wanderings (Num. xxi. 17, 18), or of the subsequent conflicts with the Canaanite peoples, such as the great song of Deborah (Judg. v.) Lyrics of this kind were in due time gathered together, perhaps combined with brief narratives explaining their origin, and it is certain that such collections preceded our existing books, for they are named and cited in them—*e.g.* the Book of the Wars of Yahaveh, Num. xxi. 14, and the Book of Yashar (the Upright), Josh. x. 13; 2 Sam. i. 18. But of the dates of these anthologies we know nothing, save in so far as the second contained David's elegy over Saul and Jonathan, and it would seem also a fragment concerning the dedication of Solomon's temple, restored by Wellhausen from the Septuagint text of 1 Kings viii. (Bleek-Wellhausen, "Einleitung in das Alte Testament," p. 236).

7. Of historical composition proper it cannot be said that Hebrew literature presents us with any very early traces. The principal narratives of the Pentateuch and the Book of Joshua have been considered by recent authorities to depend upon oral tradition, which has been reshaped many times before its final reduction to writing. The materials of which the Book of Judges is composed appear in like manner, when carefully investigated, to consist of the tales of the exploits of tribal heroes. The existence of inconsistent accounts of Saul's election as king, and of David's first introduction to him, with other similar phenomena, seems to indicate that the First Book of Samuel was put together in much the same way—from the fragments of popular tradition. But the Second Book of Samuel mentions the appointment of a regular Recorder (2 Sam. viii. 16; xx. 24) at David's court, and the minuteness of the court histories of David's later years in 2 Samuel and the early chapters of 1 Kings implies the beginning of a new care for the history of national events, and exhibits the transition from oral into written narrative. After the disruption of the monarchy this practice still continued, and royal annals were regularly kept. At Jerusalem a special class of records clustered round the temple, describing its glories and any changes in its structure or its management. The growing practice of historical record could not fail at length to draw into its range the ancient national traditions of the first immigrations into Canaan, the sojourn in Egypt, the exodus, the wanderings, the conquest. These had been handed down for many centuries in shapes flexible enough to receive additions and modifications through the readjustment of tribal relations and the changes of religious conception. At length, by the beginning of the eighth century B.C., they finally issued in the form in which they are now embodied in the document comprising the Jehovist or prophetic narratives in Genesis, Exodus, Numbers, and Joshua. This document, with the Short Code already named (sec. 5), probably formed the nucleus of our present Pentateuch.

8. The eighth century was a period of great importance in the literary as well as the religious history of Israel, for it saw prophecy surrender somewhat of the antique force which had marked it in the days of Elijah and Elisha, and take on itself the ministry of the written word. Amos, Hosea, Micah, above all Isaiah, left behind them memorials of their preaching, and the artistic form of some of their discourses is sufficient proof of the high degree of literary finish now bestowed upon compositions of this kind. Of regular and continuous production, however, there was none. The genuine discourses of Isaiah, scattered through a long career, only occupy a few pages. They were called

forth by special crises, and deal with particular events. The fragmentary condition of many of them, the evident traces of editorial revision, the irregularity of their arrangement, and their admixture with other prophecies of different style, subject, and aim, all tend to show that the recognized methods of literary treatment then were very different from what would be considered lawful now. Once started, however, the stream of prophetic literature flowed on. Applied to the sacred law at a time when the nation was in imminent danger of letting its religion sink into the lower forms of Canaanite cults, it produced the Book of Deuteronomy, the publication of which (now very generally assigned to the year 620 B.C.) proved one of the chief landmarks in the history of Israel's faith. In the writings of Jeremiah and Ezekiel the elements of actual speech are still present in a greater or less degree. But the great collection of discourses issued in Babylonia, and now appended to the Book of Isaiah, while it shows us Hebrew prophecy at its noblest height, proves at the same time how significant a change has come over the character of prophetic activity. The prophet's personality is no longer a potent factor in the national policy. It glows only through the written page. The spoken utterance has given way entirely to anonymous literary address.

9. The circumstances of the exile made it in many ways a time of new departure for Hebrew literature. Far from their ancient land, deprived of that city and temple which had been the centres of political and religious unity, without a cultus or a home, the Israelites had nothing but their literature to serve as the medium for maintaining their national religion and preserving their national bond. The collection of the national annals became a pious duty, and the whole story of their past, from the captivity to the conquest, was retold from the prophetic view of popular unfaithfulness and divine chastisement. The prophetic writings were in like manner put together and arranged in groups under the great names of old. The treasures of the national poetry, which had been accumulating since the days of David, were gathered up and enriched with new prayers and hymns. The results of that experience of life to which was given the expressive name of Chokmah or Wisdom, were sifted and set side by side, in part under the traditional authorship of Solomon; while a new path was struck out on independent lines in the great drama of the Book of Job. Above all, the entire sacred law, now consisting of the ancient prophetic traditions, the short First Code, and the Book of Deuteronomy, was recast (so it is believed) in accordance with a fresh scheme of legislation first sketched by Ezekiel, and afterwards elaborated in the priestly schools. Prefixed to it stood a brief survey of universal history, beginning with the creation and gradually narrowing its scope to the favoured line of Israel. The law-book thus prepared was carried, it would seem, from Babylonia to Jerusalem by Ezra, and there at length promulgated in the year 444 B.C. It was afterwards adopted as the basis of our present Pentateuch, the documents already existing being combined with it, though of the time and the means of this great compilation we know nothing. Thenceforth the Law, nearly in the shape in which we now have it, became the central object of Hebrew religious literature, with whose sanctity no other writings, not even those of the prophets, could compare. Two other groups came in later times to stand by its side. The first comprised the Prophets, and included, besides the books which we commonly reckon prophetic (with the exception of Daniel), the histories from Joshua to Kings. The second bore simply the name of the Writings, and served as the home of smaller collections, such as the Psalter, into which fresh materials could be continually inserted; and of later works like the series which we possess under the titles of Chronicles, Ezra, and Nehemiah, the Book of Daniel (the product of the passionate struggles of the era of Antiochus Epiphanes), and the Book of Ecclesiastes, which exhibits traces of acquaintance with the new Greek culture, and is perhaps not much more than a century removed from the birth of Christ. The period from the captivity to the advent was the age of the scribes. Something of the nervous force of the old literature had disappeared; but the sweet piety of the Psalms, the bulk of which seem to belong to the second temple, and the tender grace of the little Book of Ruth, show that the simplicity, the strength, and the devotion of the elder faith were by no means lost.

10. The stream of Hebrew literature continued to flow on, as has been shown, after the captivity; but the Hebrew language had ceased to be the language of the people. It was supplanted by the cognate Aramean (Chaldee). This was naturally adopted by the exiles in Babylonia, and among those who returned to Palestine it was employed more and more, till it became the common vernacular of the country. Some parts of the Book of Ezra and a large portion of Daniel are written in this kindred tongue. Hebrew, nevertheless, still continued to be the language of religion and of the schools, but its character was somewhat modified. A number of circumstances combined to give it a peculiar cast. Foreign influences were slowly invading both thought and speech; the legal discussions among the rabbis had led to the development of fresh modes of expression; and so it came about that the next great monument of Hebrew literature, the collection of scholastic decisions on matters of the sacred law, compiled towards the end of the second century A.D., under the title of the "Mishna," exhibits a fresh phase of the ancient language, sometimes designated the New Hebrew. The nearest approach to this within the limits of the Old Testament is to be found in Ecclesiastes. Round the Mishna there was accumulated in the succeeding centuries a vast body of explanation and comment known by the name of "Gemāra," in which, however, the Aramean language is predominant. At the same time an important work was being performed for the Old Hebrew literature. The earliest witness to the text of the Scriptures of the Old Testament is the Greek translation known by the name of the "Septuagint," which was begun at Alexandria in the middle of the third century B.C., and was carried on in later times by different hands. Now it is plain that in many cases the Greek translators had before them a text by no means identical with that now transmitted to us. One of the surest results of Old Testament study is the fact that the text of the Hebrew Scriptures, so far from being fixed, was undergoing perpetual revision and subject to constant minute changes. To this revision, and the changes involved in it, a final term was put by the labours of the teachers in the schools, out of which issued the great compilation of the Talmud. They gave to the text its authoritative form; they settled the pronunciation and the method of reading; and by the end, perhaps, of the seventh century of our era they added to the old text (which had consisted only of the consonants) an elaborate notation of vowels, long and short, full and imperfect. The old system, which had been driven to employ some of the weaker consonants to denote certain homogeneous vowel sounds, was now replaced by a complete scheme of vocal representation, providing a sign not only for every sound, but even for the absence of a sound. Along with this method of punctuation there grew up collections of marginal notes, containing the various readings which were recognized in different schools. These readings, with other remarks on peculiarities of the text, were designated by the general title of "Massorá," or tradition; and hence the common text of our present Hebrew Bibles founded on these materials is called the Massoretic Text.

11. After the decline of the great schools in the East the study of Hebrew languished, until it revived again in the West under the stimulus of Mohammedan culture. Saadiah of Faioum (born 892), Judah ben Koreish (born about 900)

in Algeria, and Menahem ben Saruk (born 910) of Tortosa, in Spain, led the way in new grammatical investigations in which the necessity of the comparison of the kindred languages was perceived and enforced. In the long succession of labourers who followed them the name of David ben Joseph Kimchi, born in Narbonne about 1160, stands out with peculiar lustre. Other writers were distinguished as commentators or philosophers, but he exerted the highest influence on all subsequent study of the languag his grammar and lexicon being the principal sources open to the Christian Hebraists of the sixteenth century. Of these the leader was Johann Reuchlin (1454-1521), whose "Rudimenta Linguæ Hebraicæ" "gave an impulse to independent research among Christian scholars, and introduced the knowledge of Hebrew into the circle of general learning." The two great teachers who have contributed most to the advancement of the study in the present century are Gesenius and Ewald, the former by his immense range of learning and clearness of method, the latter by his brilliant powers of combination and fertility of ideas, especially in the department of the syntax, which he may be almost said to have created. The labours of Christian scholars have been chiefly confined to the literature of the Old Testament, the Talmud, so far as it can be employed to illustrate the Bible, and the versions and commentaries on biblical books. But there exists, besides, an immense mass of treatises, mediæval and modern, on law, philosophy, and religion. Hebrew has been and still is the language of poetry and devotion; but it is not confined to these. In some parts of the East it is still the speech of daily life. In Germany and further east in Europe it is not only the medium of intercourse between scholars, it adapts itself to the necessities of periodical literature and the discussions of politics and science. Surprising as it may appear to those who are only acquainted with its scriptural style, it displays no little elasticity in thus accommodating the new ideas and the equally new terms of the thought and life of the nineteenth century.

HEBREWS, EPISTLE TO THE, one of the writings contained in the New Testament. There has been much controversy concerning the canonicity and authorship of this epistle from the earliest period, for though it quoted the same way as other books of onical authority by Clement, writing about the end of the first century, it was considered as destitute of authority by several of the fathers during the second and third centuries, being regarded as merely an apocryphal work of good character. In the fourth century it was accepted by Ambrose, Jerome, and Augustine, its authorship being ascribed to Paul, and this tradition prevailed until the time of the Reformation. The old controversy was, however, reopened by Cardinal Cajetan, who denied its authority, in which he was followed by Luther, while Calvin and Beza rejected only the tradition of the Pauline authorship. By modern scholars the latter tradition is generally discarded, for while the external evidence is of the slightest character the internal evidence, derived from the style, structure, and type of thought displayed in the epistle, is altogether opposed to the idea that we have in this work an epistle of Paul. According to a tradition referred to by Tertullian, the epistle was written by Barnabas, and many modern critics are disposed to regard this as being probable, while others of equal eminence ascribe it to Apollos or to Luke. Whoever the writer may have been, it is certain that he must have been a man of high intellectual attainments and of Hellenistic culture, whose home and labour lay among Jewish converts to Christianity, and one who was familiar with the ideas and teachings of Paul. There exists, however, considerable uncertainty as to which Jewish community it was first sent, Jerusalem, Rome, and Alexandria being the places that have been chiefly advocated, while some scholars regard the epistle as being directed to Jewish believers everywhere. With regard to the date of the epistle it is generally assigned to a time earlier than the destruction of Jerusalem, which took place in A.D. 70, as in the references to the temple worship it is spoken of as being in existence. The design of the writer is to strengthen the faith of the Jewish converts, who were exposed to peculiar temptations to return to Judaism; and he shows by an elaborate argument that the system of Christianity was superior to the old dispensation, and that the old covenant, with its observances and ceremonialism, was manifestly temporary and preliminary to the greater revelation of God in Christ Jesus. Hence he urges them to fidelity, strength, and patience, and warns them against the danger of apostacy. Considered as a composition, this epistle is marked by great warmth of feeling, elegance of language, and force of argument, and in beauty of style it yields to no epistle preserved in the New Testament.

HEBREWS, GOSPEL OF THE. See GOSPEL OF THE HEBREWS.

HEB'RIDES or **WESTERN ISLANDS** are scattered in the Atlantic Ocean, along the western coast of Scotland, between 55° 35′ and 59° N. lat., and 5° and 8° W. lon. They amount to nearly 200, of which seventy are permanently inhabited. They are usually divided into the Inner Hebrides and Outer Hebrides. The Inner Hebrides consist of the islands nearest the mainland, including, besides those in the Frith of Clyde, Skye, Mull, Islay, Jura, Coll, Rum, Tiree, &c. The Outer Hebrides, popularly called the "Long Island," consist of the range of islands stretching in a continuous E.N.E. and S.S.W. direction from Barra Head to the Butt of Lewis. The principal islands in the range are Barra, North and South Uist, Benbecula, and the districts of Harris and Lewis (locally called "The Lews"), which two form one island. The surface of these islands varies considerably. Some of the larger islands are mountainous, especially those near the mainland, such as Arran, Jura, Mull, and Skye, in which the elevated masses rise to the height of 2000 or 3000 feet and more above the sea. The others are in general only hilly, the most elevated portions not exceeding 1500 feet, and in some are not more than from 300 to 500 feet. The whole group is composed of hornblendic gneiss, through which granite breaks out in several places. The rivers are small but numerous, and abound in salmon, trout, and eels; many contain also several other kinds of fish. Some of the islands abound in lakes. Bute and Islay, and also several districts in the island of Skye, are considered fertile. A comparatively small portion of the surface of the whole is under cultivation. There are no natural woods on the islands, but several thousand acres have been planted.

Owing to the Gulf Stream the climate is upon the whole mild. Frost and snow are almost unknown in the smaller isles, and they seldom prevail in the larger to any considerable degree.

The great mass of the population resides within a mile of the sea-shore. From their language and customs it is evident that they are of the same stock as the inhabitants of Ireland and of the Highlands of Scotland.

Steam navigation has contributed very much to the improvement of the condition of the population of the Inner Hebrides. The herring fishery, formerly an important resource of the people, has greatly declined, as has also the manufacture of kelp, of which, at the beginning of the present century, nearly 6000 tons were produced, fetching sometimes £20 per ton. Except some distilling in Islay, and boatbuilding at Tobermory and Stornoway, the manufactures are insignificant and wholly domestic. The most profitable branch of industry is the rearing of cattle and sheep; the stock of each is estimated at 120,000. The imports are iron, groceries, salt, oatmeal, and peat-fuel in some of the islands; the principal exports being live stock, ponies, kelp, wool, cod, ling, herrings, limestone, and slate.

Most of the inhabitants are ecclesiastically connected with the Scotch Free Church. These islands were ruled mostly by sovereigns of Norwegian descent from the ninth century to 1264, when they were annexed to the crown of Scotland. The principal towns are Stornoway, a small port in Lewis, Portree in Skye, Tobermory in Mull, and Rothesay in Bute. As in the mainland portion of the Highlands, many large estates have passed from the old families into the hands of opulent modern proprietors, by whom extensive improvements have been effected.

The Hebrides belong politically to four Scotch counties. Those of them which lie in the Frith of Clyde, between the peninsula of Cantire and the coast of Ayrshire, constitute a county by themselves [see BUTE]; all the other southern Hebrides, together with the islands of Muck, Rum, and Canna, which are included in the Northern Hebrides, are annexed to the county of ARGYLE; the "Long Island," except Lewis, constitutes a part of INVERNESS; Lewis is a part of Ross; and Skye belongs to Inverness.

HEBRIDES, NEW. See NEW HEBRIDES.

HE'BRON (literally "alliance"), the name of a city belonging to the territory anciently assigned to the tribe of Judah. Its original name was *Kirjath arba*, or the city of Arba, the father of Anak (see Gen. xxiii. 2; Josh. xiv. 15). It is one of the most ancient cities of the world. Thus the sacred historian says of the Israelites—"They came to Hebron, where Ahiman, Sheshai, and Talmai, the children of Anak, were. Now Hebron was built seven years before Zoan in Egypt" (Num. xiii. 22). Zoan, or Tanis, was the ancient capital of Lower Egypt. After the conquest of Palestine, Hebron became one of the cities of refuge. Before the accession of the ten tribes to the rule of David, he occupied Hebron as a royal city. It is situated in a deep, narrow, but very fruitful valley, and is even now a place of importance. Here is the celebrated mosque which is said to contain the cenotaphs of Abraham and Sarah, of Isaac and Rebecca, of Jacob and Leah.

HEC'ATE (*Hekatê*), one of the ancient Greek divinities, the daughter of the Titan Perses and Asteria, according to Hesiod ("Theog.," 411). Her attributes correspond in most respects with those of Artemis, and it has therefore been conjectured that she may originally have been the same as Artemis. She figures in the legend of Demeter and Persephone as having, with Helios, been privileged to see the maiden carried off; and in this way she seemed also to be the moon goddess. Also she is identified with Persephone as Queen of the Under World. Hence her name, the "Three-formed Goddess," Selene (Moon), Artemis and Persephone, or Luna, Diana, and Proserpine. She is even depicted with three heads. Doubtless Hecate was an old Thracian divinity whom the Greeks sought to incorporate with their own gods in a clumsy manner. In "Macbeth" Hecate figures as the Queen of Hell, the mistress of the three witches who lure Macbeth to his ruin. The name is usually pronounced in two syllables in English, though it has three in Greek or in translations from the Greek.

HECATE'SIA, a festival celebrated by the Greeks, and more especially by the Athenians, in honour of Hecate. The numerous statues erected in honour of this goddess were termed *Hecatæa*.

HEC'ATOMB, a Greek word signifying the sacrifice of a large number of victims (*hekaton*, a hundred). Strictly speaking, the sacrifice should consist of 100 bulls, or their worth, *hekatomboios;* but even in Homer's time the number, except on occasions of national splendour, was reduced, and we read in the Iliad of a hecatomb of twelve oxen, and in the Odyssey of eighty-one oxen. Besides, inferior animals were often substituted, and Homer speaks of a hecatomb of fifty rams (Iliad, xxiii. 146). In the time of Homer it was usual only to burn the legs, fat, and intestines of the animal, the rest being eaten at the feast which succeeded the hecatomb. Hence in Athens this was the most popular form of sacrifice, as it was supposed not only to please the gods, but it likewise fed both priests and people.

HECKLES or **HACKLES** are instruments made with sharp-pointed metallic teeth, and used to separate the fibres of flax, hemp, and jute. Formerly hand labour was used for this purpose, but now a variety of machines are used for heckling, and the manufacture of heckles, which requires the exercise of much skill and care, forms a special trade known as heck-making.

HECLA, MOUNT. See ICELAND.

HEC'TARE, the principal land measure of the French, which consists of a square of 100 mètres on every side, equal to 2 acres 1 rood 35 square poles and $11\frac{1}{4}$ square yards English.

HEC'TIC FEVER, a form of fever which presents certain prominent and peculiar features with regard to its symptoms and course. It does not occur as an independent disease, but it supervenes when there is an unnatural drain upon the system beyond what nutriment can supply. Thus it is most frequently noticed in connection with consumption, in which it generally appears as that disease reaches an advanced stage; in cases where there is chronic suppuration and a large discharge of pus, such as that caused by persistent abscess; where there exists any chronic disease of the kidneys or bowels; and sometimes as a result of too prolonged suckling.

Its onset is usually of an insidious character, but as it becomes developed it is marked by elevations of temperature occurring at periodical intervals, generally morning and evening, the evening attack being the most severe, followed by profuse perspiration and a feeling of languor and depression. During the paroxysms the eyes become bright and sparkling, the respiration is quick and hurried, and a bright red spot, known as the *hectic flush*, appears on the cheek. The mind is usually unaffected during the earlier stages of the disease, but the wasting of the tissues and loss of strength may lead to mild delirium as death approaches.

The treatment of this form of fever must evidently be directed to the condition on which it depends, and if this can be cured the fever will disappear, but where this cannot be removed the fever usually has a fatal termination. See CONSUMPTION.

HEC'TOLITRE (Gr. *hekaton*, 100), a French measure of capacity for liquids containing 100 litres, equal to a tenth of a cubic mètre, or 22 imperial gallons.

HEC'TOR (Gr. *Hektôr*), the greatest of the Trojan heroes who figure in the Trojan War. He was the eldest son of Priam and Hecuba, and was married to Andromache. The poet of the Iliad describes him not only as a bold and gallant warrior, but as a hero ennobled by all the more lofty and humane virtues. The most tender passage in the Iliad is that in which Hector (vi. 369, &c.), before going to battle, takes leave of his wife and child. Hector's victory, in fair fight, over Patroclus was the determining cause of Achilles' return to the field, and hence of Hector's own death and the fall of Troy. He finally fell by the hand of Achilles, and the body was given up by the conqueror to his father Priam, but not till Achilles had brutally tied Hector by the heels to his chariot tail and dragged him thrice round the walls of Troy. Homer tells how the gods, pitying the fall of so great a hero, preserved his corpse unharmed, and eventually induced Priam to seek the Grecian camp and buy back the body of his son, while they predisposed Achilles, on the other hand, to give up his prey. The remains of Hector were buried at Troy, where funeral sacrifices were offered to him as a hero.

HEC'UBA (Greek, *Hekabê*), the wife of Priam, king of Troy, mother of Hector and of seventeen other of Priam's fifty sons. She was a Thracian princess by origin.

On the fall of Troy she was carried away as a slave by the Greeks. Her youngest son was betrayed by King Polymnestor, monarch of the Thracian Chersonese, who had undertaken to protect him in the universal ruin of Troy. Hecuba, frantic, murdered the children of Polymnestor, and blinded the faithless king himself. The Thracians stoned her, and she cursed them and leaped into the sea at a place called Kynossema (dog's tomb). Some accounts say she howled in her madness like a dog; others say she actually became a dog. There is evidently great confusion between the Trojan and some local legend. Other poets make her leap into the sea on being adjudged to Ulysses as a slave.

HED'ERIC ACID, an acid found in the seeds of the common ivy (*Hedera helix*, natural order Araliaceæ). It crystallizes in colourless needles, and is soluble in alcohol, but insoluble in water and ether. It has the acrid taste peculiar to ivy seeds. Strong sulphuric acid colours it purple. It forms a number of salts, mostly soluble in alcohol and insoluble in water. The rational formula is unknown.

HEDGE, one of the most lasting and effectual of fences. Hedges are made of various kinds of shrubs and trees, trained so as to throw out numerous branches along the stem from the surface of the earth upwards; this is done by judicious pruning when they are young. The head being cut off and the side branches shortened, numerous smaller branches spring out, which are shortened in their turn, and form a very compact mass, consisting of the ends of stumps and branches pointing in every direction. Hedges in Britain are generally formed of hawthorn. [See CRATÆGUS.] Other shrubs are cultivated with it in order to fill up the blanks at the lower parts of high hawthorn hedges. Beech is also extensively used. Those shrubs which are of a thorny nature are best adapted for hedges. Holly is on this account much in use for gardens and pleasure-grounds. Ornamental hedges are sometimes made of lime, yew, box, thorn, hornbeam, elder, sweetbriar, and privet, but they are of little use as fences.

There is a method of repairing hedges which is called *plashing*. It consists in cutting half through some of the stems near the ground, then bending the upper parts down in a horizontal or oblique position, and keeping them so by means of hooked sticks driven into the bank. Thus a live hedge is made, which fills up the gaps in the same manner as a dead hedge would have done, and the bent stems soon throw out shoots. But this should only be done when the stems are young. See FENCES.

HEDGE'HOG (*Erinaceus europæus*), a well-known animal in this country, is the type of the family Erinaceidæ, which belongs to the order INSECTIVORA. ... has the body covered with sharp strong prickles instead of hairs. The skin of the back is furnished with muscles so arranged that the animal, on bending its head and pressing its limbs upon the belly, can close itself up like a purse, and present on every part its spines to the enemy. The tail is very short. All the feet have five toes. The dental formula, as given by Professor Flower, is—

$$I. \frac{3-3}{2-2};\ c. \frac{1-1}{1-1};\ pm. \frac{3-3}{2-2};\ m. \frac{3-3}{3\cdot 3} = 36.$$

The canine teeth in each jaw are by some regarded as premolars. The innermost incisor in the upper jaw is long and single-rooted. The first two true molars in each jaw are large and tuberculated; the hindmost is very small. The ears are short and oval, the eyes bright and small. At the lower part of the body the spines degenerate into mere bristles and stout hairs. The hedgehog is about 10 inches in length, including the rudimentary tail. The brain is small, and shows a feeble degree of development.

The hedgehog is insectivorous, but also devours slugs, frogs, small snakes, and eggs, being therefore mischievous in game preserves. It inhabits copses, woods, and thick hedgerows. The hedgehog's habits are essentially nocturnal, and during the winter it remains in a torpid state, hibernating in the hollows of decayed trees and similar secure retreats. The nest is carefully constructed and rain-proof. In the early part of the summer the female produces from two to four young ones at a birth, their skin being covered with soft white elastic bristles, which in a very few days assume the ordinary hard spinous character. The cry of the hedgehog has been well described by Shakspeare as a whine. It is easily tamed, and is often kept in houses to keep down the numbers of black beetles, on which it feeds greedily. On the Continent in many places the flesh of this animal is eaten. The Romans used its prickly skin for hackling hemp.

HEDGE-SPARROW or **HEDGE-WARBLER** (*Accentor modularis*) is the name of a very common and well-known species of bird of the family Sylviidæ or Warblers. Except in the colour of its plumage the hedge-sparrow differs entirely from the common house-sparrow. It is a gentle and familiar bird, having, to use the words of Gilbert White, "a delicate song." The hedge-sparrow is very generally distributed in England about hedges and gardens, where it builds its nest of moss and roots, lined with wool and hair, completing it so early in the season that, from the hedges being bare of leaves, it is very easily discovered, and is consequently exposed to be plundered by every mischievous urchin that passes by. The eggs, four or five in number, are of a greenish colour. The birds rear two broods in a season. The Alpine Accentor (*Accentor alpinus*) is a native of the south of Europe. It has occasionally been met with in Britain.

HEDYS'ARUM, a genus of plants belonging to the order LEGUMINOSÆ. The species are herbs or undershrubs. *Hedysarum coronarium* (French honeysuckle) is a native of Spain and Italy. It has deep red or white flowers, resembling sainfoin, and is sweet-scented. In Calabria this plant grows wild in considerable abundance, and horses and mules are fed with it. It grows well in our gardens, but probably would not make a good field crop. *Hedysarum fruticosum* is a native of Siberia in sandy places. It has a pale purple flower, and is a very handsome plant. Horses eat it with avidity, and it may be made useful in fixing sand, in which it grows readily. *Hedysarum Mackenzii* is a native of Arctic America, about the Saskatchewan. The flowers are large and of a rosy-purple colour. This was described as a liquorice plant by Sir A. Mackenzie, and named after him. The whole plant has a sweet taste. It is the handsomest of the genus, growing about 2 feet high. It is quite hardy, and well suited for a mixed border. *Hedysarum obscurum* has showy purple flowers, and looks well among rocks. It grows to from 6 to 12 inches in height. It is a native of the Alps. *Hedysarum lineare* is used in Cochin-China as a stomachic, and *Hedysarum Sibiricum* is used in Siberia for the same purpose. This genus contains about fifty species, natives of Europe, North Africa, temperate and mountainous Asia, and North America. It gives its name to a tribe of Leguminosæ, Hedysareæ. The pod is formed of several convex joints, each containing a seed, separating from one another when ripe, but not bursting open. The uppermost stamen is free, the rest are joined together.

HE'GEL, GEORG WILHELM FRIEDRICH, an eminent German philosopher, was born at Stuttgart on the 27th of August, 1770, and educated at the gymnasium of his native city. At the age of eighteen he proceeded to Tübingen in order to join the classes of theology and philosophy, where he had for his class-fellow the illustrious Schelling. Dissatisfied with the prevailing system of metaphysics, Hegel endeavoured to supply its deficiencies by the works of Plato, Spinoza, and Kant; and, in the conviction that a truly philosophical comprehension can only be educed by an enlarged and diversified inquiry, he

combined with his study of philosophy an acquaintance with the natural and political sciences. Upon being admitted to the degree of doctor in philosophy, he accepted an engagement as private tutor, in which capacity he lived for some years, first in Switzerland, and afterwards at Frankfurt-on-the-Main, until, on the death of his father in 1800, he was enabled, by the inheritance of a small patrimony, to devote himself without restraint to the study of philosophy. He accordingly proceeded to Jena, where Schelling was teaching his system of *Absolute Identity*, of which Hegel was at this period one of the warmest partisans. Hegel had the good fortune at Jena to become friendly with both Goethe and Schiller, especially the former. His pages are full of the happiest quotations from Goethe's works, of which he was always an ardent admirer. Here he wrote his first philosophical work, entitled "On the Difference of the Systems of Fichte and Schelling;" which treatise, notwithstanding the sincerity with which Hegel then advocated the views of the latter, contained the germ of that dissent which was afterwards expanded into a peculiar theory. He was also associated with Schelling in conducting the *Critical Journal of Philosophy*, and among the most important of the articles contributed by him is that "On Faith and Science." In 1806, when Schelling went to Würzburg, Hegel was appointed to supply his place as lecturer; and now for the first time he openly avowed his dissatisfaction with the system of Schelling. The difference between the ideas of the master and disciple was marked still more strongly in the "Phenomenology of Mind," which was published at Bamberg, whither Hegel had retired after the battle of Jena. The "Phänomenologie des Geistes" was in fact actually finished while the battle was raging round Jena. The philosopher wrote deep into the night, eager to accomplish what he felt was an all-important work. He heard neither the roar of the cannon nor the cries of the wounded as they passed through the streets; and no one was ever more surprised than he when, issuing from his lodging to offer his bulky manuscript to a publisher, he was arrested by the French soldiers who had occupied the town.

During his retirement at Bamberg, Hegel conducted the political journal of that town with great ability and with honesty and candour. In 1808 he was called to preside over the gymnasium of Nürnberg. The benefit of the reforms he effected, both in the discipline and the studies of the school, are still gratefully noticed at the annual commemoration. During this period he married very happily. Two sons were born to him. In 1812 he published his "Logic," which was designed, with the "Phenomenology," to complete the whole body of science. Hegel employs the term logic in a very extended sense. The general merits of this work were admitted and acknowledged by the offer of a professorship at Heidelberg. His first course of lectures was attended by a numerous and distinguished class, attracted by the originality of his views, notwithstanding the great obscurity of his style. By the publication of the *Encyclopædia of Philosophical Sciences*, in 1817, his reputation as a philosopher was established, and Hegel was invited by the Prussian government to fill the chair at Berlin, which had remained vacant since the death of Fichte, in 1814. He successively published the "Philosophy of Jurisprudence;" two new editions of the *Encyclopædia;* the first volume of the second edition of his "Logic;" and several articles in the *Annals of Scientific Criticism*, which he had established as an organ of his system, and of its application to every branch of art and science. He fell a victim on the 24th November, 1831, to cholera, and was, in compliance with his express desire, buried by the side of Fichte. A collected edition of the works of Hegel, in eighteen volumes, was published at Berlin (1832–41), and a life by Rosenkranz in 1844. See also Vera's "Introduction à la Philosophie de Hegel" (Paris, 1855).

Hegel's Philosophy.—It is quite hopeless in the necessary limits of the present article to give an accurate account of Hegel's teaching, though the immense importance of it demands an outline of some of its chief positions. Further, it is so excessively distasteful to an Englishman to read works wherein Newton is stigmatized as an "empiric," as a "barbarian in thought," &c., and all his magnificent labours on gravitation and optics set aside as mere experimental work in favour of a theory which, however brilliant, is perfectly barren, that the necessity is increased for a statement in brief of what is not read in its entirety. We who know what Newton has done for us, and who gratefully recognize the fruitfulness of those researches which continually bring forth other discoveries as we press them further, need all our patience with a man who with a dash of the pen obliterates them, and who supplies their place partly with abuse, partly with logical formulæ, whereby no man has yet discovered anything whatever. Besides, in his practical science Hegel is so demonstrably absurd, and every advancing year so adds to the proof of the baselessness of his assumption, that our first tendency is to throw him aside as a paradoxical dreamer, and to wonder what has moved the world in this mass of misty rubbish.

To understand Hegel we must go back for a moment to Schelling. Schelling was younger than Hegel by five years, but he was already famous, and the successor to Fichte's chair at Jena, before his friend and fellow-student Hegel had risen from obscurity. And curiously enough, after Hegel had outdistanced Schelling during his Berlin professorship, had risen to great fame and honour, and had died, it was Schelling who in 1842, as an old man, was invited to fill his chair. Schelling's teaching thus overlapped Hegel's at each end. We know Schelling tolerably well in England through Coleridge. Coleridge was so imbued with Schelling that he would unconsciously write page after page of what was little more than brilliant paraphrase of the great German's teaching; and hence later on he was accused, very harshly and unjustly, of having attempted to pass off another's thought as his own. He always admitted his indebtedness most fully. But the result is that the doctrine due to Schelling of the identity of seeing and knowing, set out in another aspect in the famous Coleridgean phrase, "Nature is spirit visible, spirit is invisible nature," is not only well known in England, but widely accepted by many thinkers. We cannot be conscious of our own existence (that is, our subjectivity) without feeling something outside ourselves (that is, objectivity); nor can we perceive any object without also perceiving its difference from ourselves—that is, we perceive a subject at the same time. So far Fichte. Granted that everything implies its contrary as subject implies object, for instance, and that both subject and object are real contraries, says Schelling (and says Coleridge also), yet both are identified in a higher power. This higher power, his addition to the philosophy of Fichte, Schelling called the Absolute. This is the famous doctrine of *Absolute Identity* of Schelling. Hegel accepted the main views of Schelling, but he reasonably objected that this Absolute, thus merely asserted, was in fact "shot out of a pistol," and he undertook to account for its existence. Schelling had also put his doctrine of the Absolute in another way. The Absolute was, he said, at the *indifference point* between mind and nature, between ideal and real, and this view has caused his philosophy to be sometimes styled the "Indifference Philosophy." Hegel did away with such a conception in favour of that of a progressive unfolding of the idea. He teaches a progression from state to state in infinite series, as follows:—

His first point is an extension of Schelling's identity to cover the identity of contradictories. Light is darkness, and darkness light; being and nothingness are the same.

This at first seems childish trifling. But Hegel is speaking of an absolute light, a light without colour or shadow, which he truly says would be as useless for seeing as darkness itself. Mingling absolute light and absolute darkness we get what is vulgarly called light and a visible world. So with being and nothingness: absolute Being, not related to any existent thing, could as little produce a world as nothingness itself; the union of the two is conditioned existence, and this is the tangible world as we know it. But he goes further, and not only declares contradictories identical, but that one contradictory is the result of the other; as, for instance, that light is directly the outcome of darkness, and *vice versâ*. Here comes in the famous Hegelian method. Starting with any idea he declares, truly enough, that it implies its opposite (as was said above in the remarks on Schelling's teaching, following Fichte, that subject implies object and the like, which indeed the Greeks had said ages on ages previously: see HERACLITUS); but, continues Hegel, this opposite implies *its own opposite*, which is the first idea we started from. It is thrown back like a ray of reflected light. Being implies nothingness, but also nothingness implies the contrast to itself, which is Being, and we are back again from whence we set out. But we are back with a second idea added to the first, and this superadded weight causes the whole to tip over into a third form, compounded of the first two. This is stage number one. The third form soon is seen in turn, when fully developed, to imply its opposite, and that opposite to imply *its own opposite*—namely, the third form itself; recoiling upon it and combining with it, therefore, a new form of idea arises; and this is the stage number two. It is evident that we can thus go on for ever, or rather till, as Hegel teaches, in a far-off stage we find that we have touched again our first idea, and have in fact completed a logical circle. Each link in the chain is threefold, a first, a second (its opposite), and a third, which is the conjunction of the two; and each third term so produced must be conceived to begin to fill, to reach its full, and when full to show, as it were, the germ of its opposite, and thus to start a new threefold link. The opposite, rising to its full, coalesces with its former to complete the link by a new ideal production. And so the process continues. Thesis, antithesis, synthesis; being, essence, notion; universal, particular, singular—such are patterns for links in the Hegelian chain, and the third is always the base and the truth of the first and second.

We pass now to Hegel's asserted improvement of Schelling's *Absolute Identity* doctrine, namely, the much contested *Absolute Idealism.* Hegel quarrels altogether with the conception of subject and object as two poles whereof the absolute (which comprises them both) is the indifference point, but yet as two separate extremities, two realities. He asserts that the essence of all relation does not lie in the things related, which are mere phenomena, and the only reality existing in the whole series is *the relation itself.* Say that I see a tree; Schelling says the "I" and the "tree" are two manifestations of the Absolute, which is All in All, indeed which is God himself, and which includes both the "I" and the "tree." Hegel says that the relation between the "I" and the "tree" is the only manifestation concerned, and that this relation is God. "Spinoza" (to quote Hegel himself) "said God is substance. I (Hegel) say that God is more than substance, he is the Notion" (*Begriff*); that is, the perceptions, conceptions, relations binding things to things. Kant says truly that things are appearances to us, and we can never know them as things in themselves, but only by their appearances. Hegel says that they are only these appearances *and nothing more;* that our thoughts are the real things. This is so extraordinary that it will be better to add the original words in German from Hegel's "Encyklopädie," sec. 41, whence this is taken— . . . "Dass die Gedanken nicht bloss unsere Gedanken, sondern zugleich das Ansich der Dinge, und des Gegenständlichen überhaupt sind." After this one is not astonished at anything of Hegel's, not even at his notion of God, whom he pictures as only becoming conscious of himself in philosophy, for as pure Being he can, under the Hegelian doctrines, only pass into reality through a negation; now in philosophy he negatives this negation—that is, in other words, he arrives at a positive affirmation of himself.

It is not too much to say that to a person possessed of that common-sense which Hegel, as well as Schelling, so contemptuously casts on one side, these ideas and concepts are unthinkable, self-condemned; but to one who plunges into the arid waste of metaphysics, whose only sign of life is some mirage or another, nothing seems absurd, nothing totally incomprehensible. Besides, Hegel, if wrong, was so great a man, and his mind played over so vast a field, that his followers find hosts of positions to defend or to correct, and much charm may lie in that. As to its effect as a whole system on any one but Hegel himself, he is reported on excellent authority to have said with a sigh, "Only one of my disciples ever understood me, and"—after a thoughtful pause—"and *he* misunderstood me." (*Se non e vero e ben trovato.*) In England there is happily an awkward habit of letting in the daylight upon these cobwebs of the brain. What comes of them? we ask. When Hegel attacks chemistry and points to substances made up of the union of an acid and a base, and then coolly tells us that the relation is the only actuality here, that neither acid nor base exists actually, since acid means not-base and no more, and base means not-acid and no more, can we, face to face with both acid and base, believe or comprehend him? When a man is killed by a tile falling from a house, says Hegel in another example, he is not killed by the tile, but by time and space, as expressed in the velocity of the tile.

Put to the test his famous method breaks down. Perhaps he is most readily tested in history, which he views simply as developing consciousness. He is unable to evolve one fact, and in his selection of persons and epochs for examples he is most capricious. Every position he puts forward can be overthrown by examples to the contrary. His facts, too, are often wrong. Among other things he lays down his favourite three stages, in this case as affirmation, negation, and negative of negation, which last is the return to consciousness accompanied by reality. Every nation has a triple progress—the family becomes a horde, the horde a tribe, the tribe a state. The idea thus fully formed needs development on the theatre of the earth; and this, too, follows three states—first in the mountains, secondly in the plains and valleys, thirdly along coasts. The triple localization corresponds with the three states of primitive savagery, of agricultural tribal conditions, and of free commercial activity. Space forbids further examples, but it is evident that we have here a mere chimæra of history, running completely counter to known and evident facts. To sum up, the central notion of Hegel is that everything must be considered first *per se*, then in its negation—that is, as some other thing. Finally, these two terms or contradictories must be identified in some third, or they cannot exist, and this third is the *relation* between the two. This relation alone is positive and real, for it is an affirmation founded upon the negative of a negation. So long as we deal with ideas and conceptions such fantasies of thought may interest and perplex, but applied to facts they are unable to exist for one moment. History, astronomy, physics, chemistry, biology, and psychology Hegel has attacked with his universal solvent, and each and all of them has proved insoluble by it. His system, so vaunted for its universality, is not only useless, therefore, but in virtue of its perplexities and paradoxes it is

mischievous, and has indeed proved the ruin of that German philosophy which at one time promised so much, as it began its grand career with Kant.

HEGE'SIAS, the Cyrenaic Philosopher, lived in the reign of Ptolemy Philadelphus. His doctrines in the main points agreed with Aristippus, the founder of the Cyrenaic school, who maintained that pleasure was the great object of man's life; but Hegesias and his school denied that kindness, friendship, and benevolence had any independent existence, asserting that they arise and disappear with our feeling of the want of them. Happiness is a thing impossible to attain, for our body is subject to many sufferings, they said, and the soul suffers with it. Life and death are equally desirable. Nothing is by nature either agreeable or disagreeable, but becomes so through the circumstances in which a man lives. A wise person therefore looks upon life with indifference, and regards nothing as in itself absolutely worth striving for. The value of everything is reduced in this way to its value as it affects ourselves (of course our highest selves is understood to be meant).

HEG'IRA or **HEDJ'RAH** (Arabic *Hedjraht al Nebi*, the Prophet's departure), the commencement of the Mohammedan era. The first efforts of the Prophet in the proclamation of his system were directed to his kinsmen and fellow-townsmen of the city of Mecca, but they met with very little success, and after enduring much persecution he found his life was in danger, and he was compelled to flee secretly to Medina on 13th September, 622. At Medina he made many converts, and received so much assistance from its people in the wars he began to make against his adversaries, that the rise of Mohammedanism may be said to date from the time of his leaving Mecca. When, however, the Caliph Omar determined to make this event the starting-point of a new era, he took the first day of the first month of the year of the flight as the commencement, so that the Mohammedan calendar dates from 16th July, 622 A.D. The Mohammedan year is a lunar year, and is therefore shorter than by 10 days 21 hours and 14⅞ seconds.

HEID'ELBERG, a city in the Baden circle of Lower Rhine, is situated in one of the most beautiful parts of Germany, on the left bank of the Neckar, on the Baden and Main-Neckar Railway, 32 miles N.N.E. of Carlsruhe. The population in 1881 was 24,417. The town is between the river and the mountains, which here form the eastern boundary of the valley of the Rhine. From one of these mountains, called Königstuhl (2000 feet high), on the summit of which is a lofty tower, there is a magnificent view of some of the most beautiful scenery in Germany. The castle, which was the elector palatine's residence, stands on the lower parts of the Königstuhl; it has remained a ruin since 1764, when it was struck by lightning and rendered wholly uninhabitable. In the cellar underneath it is the celebrated Heidelberg tun, which is capable of containing 800 hogsheads, but has not been filled since 1769. The town is chiefly celebrated for its university, which was founded in 1386, and is the oldest in Germany. The university buildings, no way remarkable, stand in a small square in the centre of the town. In a separate building is the university library, which contains 300,000 volumes and several rare manuscripts. The university is well attended, has a large staff of professors and teachers, and is well endowed. There is also a college for junior students, numerous government elementary schools, botanic gardens, and a museum.

The streets of the town are narrow. Among the more remarkable buildings are—the church dedicated to the Holy Ghost; the Church of St. Peter, the oldest in the town, and memorably connected with Jerome of Prague, who nailed to its door a summary of the reformed doctrine which he preached to a multitude in the churchyard; the Museum Club; and the stone bridge over the Neckar, on which is a statue of the palatine Karl Theodor. The chief trade of the town is in tobacco and oil; there are breweries and tobacco factories. Wax-lights, leather, and musical instruments are also manufactured. The cheapness of living, and the beautiful situation of the town, have caused many foreigners to settle there. Heidelberg was the residence of the electors palatine from the time of Ruprecht I. till 1720, when the electors removed to Mannheim.

HEIGHTS, MEASUREMENT OF. In the article ALTITUDE the methods of ascertaining height by trigonometrical means, by shadows, and by optical reflection are touched upon; and in the article BOILING OF LIQUIDS another method is indicated, and may now be more fully considered.

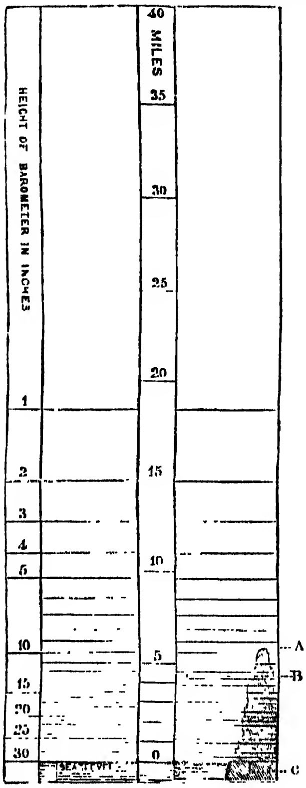
As water boils *in vacuo* at 72° Fahr., on the top of Mont Blanc at 178°, and at the sea-level at 212°, it is evident that (as might have been expected *a priori*) the boiling-point varies with the pressure of the atmosphere. Numerous experiments have made out a rough law that to every degree of fall in the boiling-point an elevation of about 500 feet above the sea-level corresponds, for distances near that level. Above 2500 feet it needs an elevation of 520 feet for a degree, at 5000 feet it needs over 530 feet of elevation for a degree, and so on. A little instrument, called a *hypsometer*, serves for the purpose of this computation. It is a little boiler heated by a spirit lamp, the boiler terminating in a tube which has a thermometer passing through the top, and thus dipping into the steam, which fills the tube. The steam escapes by a small hole near the top. The temperature is read off the projecting end of the thermometer. The average computation for 000 feet above sea-level is found not to lead to any sensibly great errors. Therefore the formula

$$h = 530\ (212 - t)$$

may be used, where t is the observed temperature, and 212 the boiling-point at sea-level, and where therefore 530 times their difference (or the number of degrees of *fall*) give the height of the place of observation, or h.

Another method of ascertaining heights, really based on the same principle, involves the direct use of the BAROMETER. There being less vertical height of atmosphere above us as we ascend a mountain or rise in a balloon, it follows that only a smaller column of mercury can be sustained by it. A column of about 30 inches high is sustained at the sea-level under fair-weather conditions; therefore, as mercury is about 10,500 times the weight of air at that level, we might expect a fall of an inch for the ascent of every 875 feet, since 10,500 divided by 12 (inches) gives 875. But the air is not of equal density throughout; its own pressure upon itself by gravitation co-operates with other causes to make the lower strata far denser than those above, and instead of 5 miles, which would be its height if every one of the 30 barometric inches corresponded to just 10,500 vertical inches of air, it is believed to be about 200 miles high. The upper strata are excessively rare, the lower strata, those which we know anything about, being comparatively very dense. At 40 miles high the air is so rarefied that it ceases to refract the sun's rays, and this therefore, rather than the supposed possible limit of 200 miles, is usually taken as the practical boundary of the air. But in 1862 Glaisher, in a famous balloon ascent, reached an elevation of 7 miles, and this proved to be at great risk, for he found it almost impossible to breathe. Thus we got some nearer notion of the rapidity of diminution of the density of the air. But it may be taken as an approximation for ordinary heights, as of mountains, &c., that in the same ratio, by arithmetical progression, as the height increases, so in like ratio, but by geometrical progression, the pressure and density decrease; and in a rough way this may be put into the statement that near the sea-level the barometer falls an inch for about every 900 feet of

elevation. In the annexed figure a more exact computation is given. A shows the height of Mount Everest in the Himalayas (29,002 feet) with a barometric column of less than 10 inches of mercury in height, and B represents the height of the loftiest summit in the New World,



Aconcagua, in the Andes of Chili (23,290 feet) with a barometer of 12½ inches high. Greater elevations are also indicated according to the best computations.

HEI'NE, HEINRICH, a celebrated German poet and journalist, was born at Düsseldorf, on the 13th December, 1799, of Jewish parents. In his memoirs he speaks of his father, who was engaged in commercial pursuits, as "possessing no real calculating commercial mind," but though limited in his means he was a man of a kind and charitable disposition. His mother was a woman of superior intellect and character, and he ever regarded her with the most passionate affection. The chief member of the Heine family was an uncle, Solomon Heine, who held a high position as a banker, and who endeavoured to engage the young Heinrich in business, but finding him averse to it advanced him money to enable him to study at a university, on the condition that he should devote himself to law. Heine accordingly proceeded to Bonn, and afterwards went to Göttingen and Berlin. He appears during this period to have devoted himself chiefly to the study of literature, but in 1825 he returned to Göttingen and took his degree in law, becoming for this purpose a Christian and accepting baptism. He had already published in 1822 a volume of poems, and in the following year two tragedies "Almansor" and "William Ratcliff," neither of which had attracted any attention; but after residing at Munich and visiting Italy he published between 1826 and 1831 a description of his travels, the "Reisebilder," which was very favourably received and gained him considerable fame as a writer. This impression was deepened by his "Book of Songs" (Buch der Lieder), published in 1827, which beyond question signalizes an epoch in the history of German poetry. The same year he accepted the post of joint editorship of the *Allgemeine Politische Annalen*, which he retained until 1831, when owing to his political satires he found it necessary to choose between exile and an imprisonment in the Prussian fortress of Spandau, where he had been informed by a high legal functionary that "it was very cold in the winter, where no oysters came so far from the sea, and where the inhabitants caught no game except the flies that fell into their soup." Heine chose exile and removed to Paris, where he found for a long time a congenial home, living an erratic careless life, earning a moderate income by his contributions to journalistic literature, and being in the receipt of a secret pension from the government of Louis Phillippe between the years 1836–48. In the latter year he was seized by a painful and incurable disease, called by the physicians consumption of the spinal cord, which confined him to his bed, and though he lingered on for seven years he was scarcely ever able to leave his room. He lost the use of his lower limbs, the muscles of his eyelids became relaxed, so that he had to lift them with his fingers in order to see, and he was tormented by periods of acute pain and of prolonged sleeplessness. But the victory of mind over matter was never more triumphantly displayed than in the case of Heine. From his "mattress-grave," as he termed it, he wrote cheerful and lively letters to his mother so as to keep from her the knowledge of his condition, and here also he composed some of the best of his poetry. He was faithfully tended by his wife, and his last years were cheered by a Platonic attachment with a lady whom he called "La Mouche," but whose real name, Camille Selden, was not made public until 1884. He died 17th February, 1856, and was buried in the cemetery of Montmartre.

A humorist of the first rank, master of the most delicate irony, a consummate poet, a profound critic, and an unrivalled wit, Heine attempted almost every form of literature, and failed in nothing that he attempted. His poetry is marked by clearness, sweetness, and an exquisite pathos and depth of feeling, though at times these give way to a spirit of mockery and bitterness. Many of his poems and songs seem to baffle translation and defy reproduction, like the lyrics of Goethe or the gems of Greek anthology, but in their own language they have gained an imperishable renown. His prose writings, though comparatively neglected, are characterized by deep thought, abundant wit and humour, and a spirit of mocking ridicule which spares no one in its attacks.

A complete edition of his works was published in twenty vols. at Hamburg in 1865. The "Book of Songs" was published in English in 1856, and a complete translation of his poems by E. A. Bowring was issued as a volume of Bohn's Standard Library in 1859. See "The Life, Work, and Opinions of Heinrich Heine," by W. Stigand (London, 1878), and "Les Derniers Jours de Henri Heine," by Camille Selden (Paris and London, 1884).

HEIR, by the law of England, is he who succeeds by right of blood to the real property or lands, tenements, and hereditaments of the deceased owner, designated by the correlative term of ancestor, not given away from him by will. The English law which determines the succession to personal property, when uncontrolled by local custom, is contained in the Statutes of Distributions (22 & 23 Car. II. c. 10; 29 Car. II. c. 3; and 1 Jac. II. c. 17), which are founded upon the provisions of the civil law. The persons so entitled are not called heirs, but next of kin.

The several rules of descent which regulate the right to succeed to real property spring from the system of feudal tenures, but were somewhat modified by the statute of 3 & 4 Will. IV. c. 106. See DESCENT, FEUDAL SYSTEM

Heir, in Scotch law, is a flexible term, and may be applied either to the heir-at-law or to the heir by destination. It may denote the party who takes the movable estate, as well as the heir who succeeds to the heritable property. No nomination to be the testator's heir will confer upon the person so appointed any right of succession. But since the late Acts any words sufficiently expressing his meaning will suffice to convey either realty or personalty as the testator wishes.

In Roman law the heir was he who succeeded to the *persona* or whole civil rights of his ancestor (Dig. L. 17, 128). There was no distinction between personal and real property acknowledged by that law, and heirs succeeded to both indifferently in certain proportions, varying in accordance with their relationship to the deceased.

HEIR-APPARENT, in English law, is he whose right of inheritance is indefeasible, as being the eldest son, provided he outlives his ancestor. In Scotch law he who, after the death of his ancestor, is entitled to enter upon the inheritance, is thus styled before his actual entry.

Heir presumptive, by the law of England, is he who, if his ancestor should die immediately, would, in the present circumstances, be his heir, but whose right of inheritance may be defeated by the birth of some nearer heir. The eldest brother or nephew of a man who has no children is heir-presumptive. Properly speaking, this term does not occur in Scotch law.

HEIR'ESS is a female heir where there are no male heirs to succeed. When there are several sisters equally entitled to property they are called co-heiresses or, legally speaking, co parceners in England, and heirs-portioners in Scotland.

Peerages, dignities, and titles of honour descend to the eldest heir-portioner, unless she is excluded from their enjoyment; and she has also right to the mansion-house of a country estate, without making compensation for it to her sisters, but not to a house in town.

HEIR'LOOMS are such goods and personal chattels as, contrary to the nature of chattels, go to the heir by special custom along with the inheritance, and not to the executor of the last proprietor. See CHATTELS; HEIRSHIP MOVABLES.

HEIRSHIP MOVABLES, in the law of Scotland, are articles belonging to a deceased proprietor who was a baron, prelate, or burgess, and to which his heir is entitled, though excluded from any share of his ancestor's movable succession, that he may not enter to his predecessor's dwelling-house quite dismantled by the executors. The heir succeeds without service, but should he die without getting possession they go to the heir of the original proprietor. A list of the articles which form the subjects of heirship is given in the appendix to Sir Thomas Hope's "Minor Practicks," p. 538. They embrace the best articles of furniture in every house belonging to the deceased, articles of farm stock not raised or fed for sale, and generally the best of such subjects as may be necessary to set agoing his establishment. They are the same as HEIRLOOMS in English law.

HEL, in the Norse mythology, is the dark terrible Queen of the Shadowland, who brought death into the world. Her realm is Helheim, the abode of the dead, and Nifelheim. She is the earth-mother who watches over life and growth, and when man's course is run she calls him to herself. In conformity with this, half her face was blooming and half corpse-like. Her power ceases in the battlefield; there the Walkyries, daughters of Odin, inspire the combatants and decide their fate. Those who died fighting went to the glorious Walhalla, not to gloomy Helheim.

Hel was the child of the god of deceit and treachery, Loki, by the giantess Angurboda (anguish-bringer). Her brothers were Fenris the Wolf and Jörmungander the World-snake. At sight of Hel all things mortal stiffened into death, and the Ases (gods) themselves shuddered. Finally, Odin seized Hel and the Snake and flung them far out of Asgard for ever. The Snake coiled itself round the world, there to await the end of all things. But Hel fell for nine days through Nifelheim, land of mists and morasses, into Helheim, land of the dead. Here the monstrous dog Garn guarded the gate, his jaws dripping with blood, and the dark river Gioll surrounded it on every side. For evildoers great caldrons boiled, or dragons gaped with wide mouths, or caves yawned to receive them, from whose roofs hung serpents distilling venom, the touch of which was torment unspeakable.

HEL'DER, a fortified maritime town of the Netherlands, in the province of North Holland, at its northern extremity, 41 miles N.N.W. of Amsterdam, with which it communicates by the Helder Canal, 50 miles long, 125 feet broad and 21 feet deep, enabling ships of large burden to avoid the navigation of the Zuyder Zee. The town is separated from the island of Texel by the Marsdiep, 2 miles across. It has a town-house and other public edifices, and manufactures of leather, beer, and gunpowder. The number of inhabitants in 1884 was 20,000. Near this Van Tromp was killed in action in 1653. The place was taken by the British, under Abercrombie, in 1799. It was made a fortress of the first class by Napoleon I.

HELEN OF TROY or **HEL'ENA** (Greek, *Hélenê*), the heroine of the cycle of myths relating to the Trojan War, was a Jove-born princess. She was the child of Zeus by Leda, the wife of Tyndareus, king of Sparta. The legend varies, however, as to herself and her brothers, the twins Castor and Pollux (*Polydeukês*): one form, which is Homer's version, asserting that Helen was the daugther of Zeus, and her brothers sons of Tyndareus, and the other recognizing the Dioscuri as children of Zeus and their sister Helen as the legitimate daughter of Tyndareus and Leda. Zeus visited Leda in the form of a swan; and a late form of the legend makes Leda take the swan's form also and lay two eggs, from one of which issue Castor and Pollux and from the other Helen.

Helen grew up to be the most beautiful woman in the whole world. All the princes of Greece sought her in marriage. Theseus carried her off when but a girl, but when he once left Athens her brothers rescued her during his absence. The contentions for her hand became so dangerous, and Tyndareus saw himself so certain of making but one friend and a large number of enemies when he should decide, that he exacted an oath from the princes to abide by his choice and to protect Helen after her marriage. This being agreed to he allowed Helen to choose, and she fixed upon Menelaos, son of Atreus, and brother of Agamemnon, the most powerful prince of Greece. But Paris, the son of Priam, king of Troy in Asia Minor, had won the favour of Aphrodite by deciding in her favour a wager between her and the goddesses Hera and Athena as to who was the most beautiful of the three, and he had been promised as a reward the possession of the most lovely woman in the world. Protected by the goddess, Paris sailed to Greece, was welcomed by Menelaos most hospitably, and profited by his friendship to decoy Helen to his boat by taking the shape of her husband Menelaos, a device of Aphrodite; or others say he seized Helen by force, and yet others that she followed him willingly. On learning his loss Menelaos went over to Troy to demand her return, but managed so ill as to cause the high-spirited Trojans to reject his prayer. He then called on the Greek princes to redeem their oath, and the famous ten years' siege of Troy was the result. Homer always shows Helen as dignified, as truly Greek at heart, and as winning the respect and admiration of both armies: in a most difficult position she is made to bear herself nobly. No tinge of frailty stains her, and we are not shocked when at the fall of Troy she returns home

with Menelaos to live happily with him for many years in Sparta. Paris on the other hand, effeminate, idle, and cowardly, is depicted by Homer as detested not only by his foes but by those of his own house, for the woes his crime had brought upon them. Homer describes Telemachos, the son of Ulysses (Odysseus), as present at the marriage feast of Helen's daughter Hermione with Pyrrhos, son of Achilles, and in the Odyssey the god Proteus prophesies that she and her husband Menelaos will not die, but will be taken to Elysium by the gods themselves. Later legends, however, narrated the cause of her death as due to the persecution of the sons of Menelaos, who drove her to Rhodes, where she perished at the hands of the Rhodians.

Herodotus tells a curious myth which the Egyptians told him. They alleged that the true Helen never was in Troy at all, but was detained in Egypt when Paris touched there on his journey, and was restored to Menelaos after the siege as pure as when she left Greece. But this leaves unanswered the awkward question why the Egyptians did not stop the long and terrible siege by giving Menelaos intelligence of Helen's whereabouts, instead of leaving him to enter Troy and find out the deception for himself.

HEL'ENA, ST. (FLAVIA JULIA HELENA), the mother of Constantine, the first Christian emperor, was asserted by the courtly historians to have been of royal birth, a native princess of Britain or of Caledonia. Gibbon, on the contrary, says she was the child of an innkeeper in Britain, and it may be taken as proved that however uncertain both the birth and nationality were, she was of very humble origin. The calumny of some of the pagan historians that she was not married to Constantine Chlorus is disproved by the fact that Diocletian, when he made Chlorus a partner in the empire in 292 A.D., forced him to divorce Helena in favour of a more dignified consort.

Constantine her son, when he rose to the purple, had the magnanimity to bring forward his lowly-born divorced mother from her obscurity, to style her empress (Augusta), and in every way to honour her, building cities in her name, founding colleges for orphans under her patronage, &c. Helena very early became a Christian. Some writers say she influenced her son to take the decided step of adopting the Christian religion as his personal faith, though she could not induce him to decree it as the national worship. Others, and perhaps more reliably, say that Helena was converted at her son's instance, at the same time as the bulk of the court. But what is certain is that while the emperor her son remained somewhat easy and lukewarm in his new faith Helena became a zealous professor. She set out on a pilgrimage for the Holy Land, and brought back the true cross, or what men professed to be such. She also discovered and ordered to be protected the sepulchre which received the body of Jesus, or the cavern which was universally believed to have been thus for ever made holy and precious. Seeing that not quite three centuries had elapsed since the crucifixion it is not impossible that these discoveries may have been true. Sceptics decline to admit them upon the evidence, but most Christians have chosen to accept them and to venerate them. One thing Helena brought back, however, which it would seem every fair-thinking man must admit to be in all probability genuine. This is the staircase of marble belonging to the Roman Prætorium at Jerusalem, and now preserved at Rome, under the title of the *Scala Santa* (the Holy Stairs), in a separate building close by the Lateran Church and Palace. Jesus must have walked over the stairs of the Prætorium on his way to Calvary, and since they formed part of a public building the repairs or alterations of which would be matter of record, it would appear not unreasonable to think that we have before us in the staircase reverently brought away by St. Helena something actually touched by Jesus during his life upon earth. In the absence of any other undoubted personal memorial of him, these blocks of marble become deeply precious. Pilgrims ascended them upon their knees in mediæval times until the stone began to wear away; the stairs are therefore now encased in wood. Even in our day the kneeling procession still continues; but it is not necessary to go so far as to approve or take part in that ceremony to feel a deep gratitude to St. Helena for this one scanty fact connecting us tangibly, however slightly, with Jesus. For these services and for her warm protection of the Christians Helena was sainted by a grateful church. Apart from religious matters she was universally esteemed, and worthily filled her exalted station as empress-mother. She died in 328 at an advanced age.

HELE'NA, ST., an island in the Atlantic Ocean, 1200 miles west of the coast of Benguela in South Africa, and 850 from the Island of Ascension, the nearest land. Seen at a distance, it appears like a lofty mass of barren rocks rising in a pyramidal form; on a nearer approach, rugged and almost perpendicular cliffs, from 600 to 1200 feet high, are seen encompassing the island all round, broken through in several places by deep chasms which open to the sea-shore. One of the principal of these openings is called James' Valley, on the north-west coast of the island, and at the opening of it to the sea is James' Town, the only town and port of the island, which is defended by strong batteries and is the residence of the authorities. It has an excellent harbour, a handsome church, and several good official residences. Ascending James' Valley, we arrive at the plain or table-land of Longwood, situated in the eastern part of the island, and consisting of 1500 acres of fine land, nearly 2000 feet above the sea, sloping gently towards the south-east. Longwood House, now in ruins, was the place of Napoleon's confinement and death. In the centre of the island rises Diana's Peak, 2693 feet high. The population in 1881 was 4500. Viewed from the sea, the island appears barren; but the interior is covered with verdure, and is watered by abundant springs. The agricultural state of the island is very low, and the cattle and sheep are of very inferior quality. Some thousands of acres of grazing land are entirely unoccupied, and the supply of vegetables and fruit is also limited. The area of the island is about 45 square miles, its length 10 miles, and its width 8 miles.

The island was discovered by the Portuguese on St. Helena's day (hence its name), 22nd May, 1502. It was afterwards taken possession of by the Dutch, who abandoned it in 1651, when the English East India Company then took possession of it, and it became a place of call for their ships between India and Europe. It was made over to the British crown in 1833. It was formerly visited by ships returning from India for fresh provisions and water; but since the opening of the Suez Canal this source of revenue to the island has ceased, and such was the effect on its finances that a grant-in-aid had to be made to it by the mother country in 1877. The residence here, from 15th October, 1815, till his death on 5th May, 1821, of the deposed French emperor, Napoleon I., forms the chief event in the annals of the island.

HEL'ENIN, a crystalline substance obtained from the root of elecampane (*Inula Helenium*, natural order Compositæ). It crystallizes in colourless prisms, odourless and tasteless. It is soluble in alcohol and ether, but insoluble in water, and melts at 72° C. (162° Fahr.) Sulphuric acid colours it red. The formula is $C_{21}H_{28}O_3$. Chlorine converts it into chlorhelenin, $C_{21}H_{24}Cl_4O_3$.

HELI'ACAL RISING (Gr. *helios*, the sun), a term applied to the rising of a star when it takes place just before that of the sun. If we suppose a star not very far from the sun's orbit, then, as the sun approaches that star it will become for a season permanently invisible, for it will rise after the sun and set after it also, the heavens remaining too light in the quarter of sunset to permit the star to

be seen. But as soon as the orbital motion of the sun has carried it past the star, the latter will begin to rise first, and in process of time will rise so much before the sun as to become visible just before daylight. In this case it is said to rise heliacally; thus a star sets heliacally before its season of disappearance, and rises heliacally after its reappearance. The successive heliacal risings of stars thus form a continued sign of the seasons, and were used for this purpose among some ancient nations. And as the precession of the equinoxes slowly changes the offices of different stars with respect to the seasons, an ancient record of the time of the year when a given star rose heliacally would enable us to make a rough guess at the number of centuries elapsed since the time of the observation. Upon such a basis Newton rested a great part of his system of chronology, taking the descriptions of the heliacal risings of stars from Hesiod.

HELIÆ'A, among the Athenians, a court of justice, which was next in importance to the Areopagus. It was generally composed of 500 members; and sometimes, in important cases, of more. The judges, in awarding their verdict, made use of black and white beans, which were cast into two separate urns, and the suffrages numbered before a presiding magistrate; if there were a majority of the white beans it was considered as equivalent to an acquittal.

HE'LIAND, THE (which is equivalent to *Heiland*, Saviour), is an ancient Saxon work of the tenth century, comprising a harmony of the Gospels in alliterative verse. It is in Saxon, not Old English (Old English being often miscalled Anglo-Saxon), the tongue of the Saxons of the Lower Rhine, and is sometimes called Dano-Saxon or Old Saxon. Philologically the Heliand is of immense value therefore, if only to show the fact that Old English was a new and distinct variety of speech formed by the fusion of many elements, and by no means identical with any continental tongue, Saxon or other. A line or two of the Heliand will show that it is far nearer German than English. This is the Song of the Angels:—

Nu is Crist geboran
An thesero selbun naht
Salig barn Godes
An thera Davides burg
Drohtin the Gode.

When translated it runs thus:—

Now is Christ born
On this selfsame night,
Blessed Child of God,
In the city of David;
The Lord, the Good.

The verse scheme is simple. Each verse has three accents, but unlimited syllables. In each pair of verses some consonant is twice sounded in the first verse of the pair, and once in the first accent in the second verse. The first line of the extract is the second of a pair whose letter is *n*. The alliterative letter of lines 2 and 3 is *s*, and that of lines 4 and 5 is *d*.

HELIAN'THEMUM (Sun-rose), a genus of plants belonging to the order CISTINEÆ. There are about 100 species enumerated, which are distributed in various parts of the world; they are chiefly found in the south of Europe, the north of Africa, and a few species in America. *Helianthemum guttatum* is an erect herbaceous plant. The flowers are yellow with a deep red spot at the base of each petal. It is a native of France, Italy, Spain, Portugal, and Turkey. *Helianthemum canum* (the hoary sun-rose) has small yellow flowers. It is a native of the south of France and Germany, and rarely found in Britain. *Helianthemum vulgare* (the common rock-rose) is a native of Europe, North Africa, and West Asia. It is found in Britain in dry hilly pastures. There is a very beautiful variety with double pale yellow flowers. *Helianthemum tuberaria*, a native of Southern Europe and North Africa, is well worth cultivating, especially for the rock-garden. It is perennial, from 6 to 12 inches high, with broad leaves. The flower is 2 inches across, resembling a single yellow rose, with a dark centre. Almost all the species of Helianthemum are elegant plants, hardy, and easily cultivated. In this genus there are five petals, many stamens, which spread out when touched, three placentas, three valves, and numerous ovules. Many species have two forms of flowers, some having no petals and few stamens.

HEL'ICIN, a substance obtained from salicin by the action of dilute nitric acid. It is a neutral body, crystallizing in small needles. It is very bitter, slightly soluble in cold, very soluble in boiling water and in alcohol, but insoluble in ether. It melts at 175° C. (347° Fahr.) The formula is $C_{13}H_{16}O_7$, and it is derived from salicin ($C_{13}H_{18}O_7$) by the abstraction of two atoms of hydrogen. It is a glucoside, and splits up when heated with dilute acids or alkalies into glucose and hydride of salicyl. It combines with chlorine and bromine, forming chlorhelicin ($C_{13}H_{15}ClO_7$) and bromhelicin ($C_{13}H_{15}BrO_7$).

HEL'ICON (*Helikôn*), the Zagora of modern Turkey, is a lofty and wild mountainous range in Bœotia, forming part of the north shore of the Gulf of Corinth. Its romantic beauties led the ancient Greeks to people it with deities, and more especially those who presided over poetry and the arts. The fountains or springs at the foot of Helicon, particularly those of Aganippê and Hippokrênê, were sacred to the Muses, and believed to yield inspiration to those who drank of them. The latter ("fountain of the horse") rose in a small hollow, believed to be the footprint of the winged horse of the Muses, Pegasus (Pêgasos). The nine daughters of Pierus, so runs the tale in the Greek mythology, contended in song and the other fine arts with the nine Muses; but when the latter began their display, the rivers stood still, and Helicon in rapture raised his head until it touched the sky. Alarmed at the size of the mountain the gods ordered Pegasus to check its increase, and from the blow of his thundering hoof Hippokrênê rushed forth. It is often called the Pierian spring, as in the well-known line of Pope:—

"Drink deep! or taste not the Pierian spring."

The Muses are also often called Pierides for a similar reason. Pieria is not the district near Helicon, but near Olympus, and forms part of the shore of Macedonia. It was the kingdom of the King Pierus of the legend. The remark is necessary, from the "Pierian spring" (Bœotia) being presumed to be in Pieria (Macedonia). Mount Helicon is not unfrequently ignorantly compared with the far-distant Mount Olympus. Apollo was worshipped on Mount Helicon, which was held to be one of his favourite seats—a notion which grew up partly from the effect upon a poetic mind of the wild and romantic scenery, partly on account of the miraculous fountains, and partly, it may be, on account of the healing plants which grew there, and which were all sacred to Apollo.

HEL'IER'S, ST., the capital of the Island of Jersey, is toward the south-east point of St. Aubin's Bay and fronts the sea. In external appearance it is much on a level with English country towns of the same size, except that the ramparts of Fort Regent, overtopping the buildings, give to the place the appearance of a continental town. It has been much improved of late years, streets have been widened, houses rebuilt, the suburbs extended, and a largely augmented supply of water obtained. The principal public buildings are—the theatre, court-house, prison, lunatic asylum, and Victoria College, opened in 1852. There are several churches, and good places of worship for dissenters. St. Helier's has two fortresses: Elizabeth Castle, on a rock in the bay communicating at low water with the town, and

Fort Regent, a fortification commanding the town, of great strength. It was constructed in 1806, at a cost of £800,000. The population in 1881 was 28,020. The old harbour is formed by two piers, jutting out into the bay, at the south end of the town. A new harbour incloses a large water area, thoroughly sheltered in all states of wind and weather, and one end of which forms a fine pier and landing place for steamers at all states of the tide. St. Helier's has a large number of summer visitors from both England and France. There is an active trade with England and France.

HEL'IGOLAND or **HELGOLAND**, an island in the German Ocean, about 35 miles from the mouth of the Elbe, consists of a high cliff and a beach of white sand. The highest part of the cliff rises almost perpendicularly about 200 feet above the sea. The ascent to it is by a flight of 180 steps. The summit is a tolerably level plain. About a quarter of a mile to the south-east is Sand Island, a strip of low land which was originally united to the rock, but which became separated during a storm in 1720. In former ages this was of much greater extent; but the action of the sea has considerably diminished it. The inhabitants of the rock, which is 2 miles 980 yards in circumference, numbered 2001 in 1881. They are descended from the Frieslanders, and subsist chiefly by fishing and by acting as pilots. The English took the island from the Danes in 1807, and it was formally ceded to them in 1814. They have erected a lighthouse on the cliff. The island is frequented as a watering-place. Heligoland was noted in pagan times for its temples, and at a later period for the number of its religious houses, and hence probably its name of "Holy Island;" at present there is but one church. There is now no garrison on the island. It is under a governor appointed by the crown, who has the aid of a small council; and there is a court of law, over which the governor presides. He has the assistance of a magistrate for trial of slight offences. The island, however, is very free from crime. A few cannon on an earthwork and a few coastguardsmen are its only defence.

HELIOCEN'TRIC (having the sun as a centre), a term applied to the place of a planet, as seen from the centre of the sun, in opposition to its *geocentric* place, as seen from the centre of the earth.

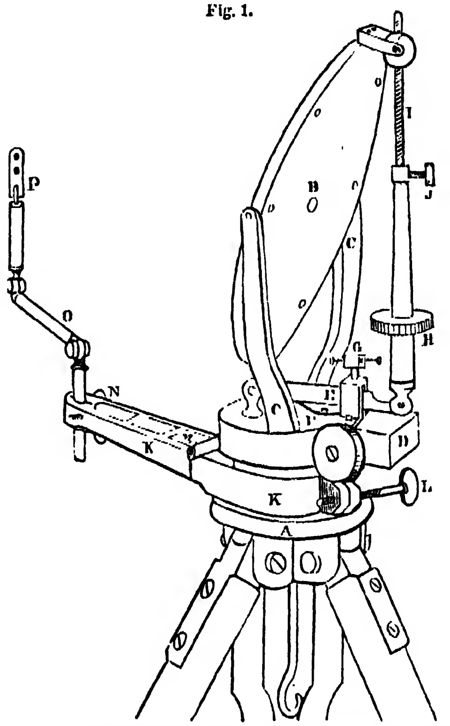
HELIODO'RUS (*Hēliodōros*), a not uncommon name among the Greeks. To a Greek of the name Pliny was indebted for his account of the works of art in the Acropolis at Athens, and Horace and Juvenal allude to philosophers and rhetoricians of note bearing this name. The Greek who has made the name famous, however, is none of these, but is a Thessalian Christian bishop, Syrian by birth, who in the fourth century wrote a most charming romance in Greek called "Æthiopica." The hero and heroine, Theagenes and Chariclcia, are carried through a surprising series of adventures in a manner which is still interesting to read. The book was for centuries a great favourite, and tended largely to mould the style of the romances of the early middle ages. Indeed its power revived in a most wonderful way much later; for at the time of the Renaissance, a translation of it by Underdown falling into the hands of Sir Philip Sidney, was the means of bringing into the world his famous romance of "Arcadia." Sidney, indeed, makes no secret of his model; alluding to the "Æthiopian Historie" of this author, in his "Defence of Poesy" (1581), as a "sugared invention of a picture of love," which though "writ in prose" is, so he asserts, true poetry. A work praised by Sidney becomes by that fact immortal, as need hardly be said. The best edition of Heliodorus in the original is Mitscherlich's "Script. Erot. Græci" (Bipont. 1792), and the best English translation is that by Smith (London, 1855). The French translation, edited and annotated by the eminent Paul Louis Courier, is very readable and elegant (Paris, 1822).

HELIOGAB'ALUS. See Elagabalus.

HE'LIOGRAPH is the name applied to an instrument for communicating between distant points by means of signals, obtained by reflecting the rays of the sun from a mirror or combination of mirrors in the requisite direction. The idea is an old one, and for centuries the rays of the sun have been used for signalling purposes; but it is only in recent years that it has been systematically employed in the British army and navy. It proved of very great service in the Zulu campaign of 1879, in Afghanistan in 1879–80, and in Egypt in 1882 and 1884.

The heliograph at present in use in the British army consists of a mirror, B in fig. 1, mounted in a U-frame, C C, fixed to a plate which moves horizontally on a second plate fixed on the head of a tripod stand, A. The legs of the

Fig. 1.

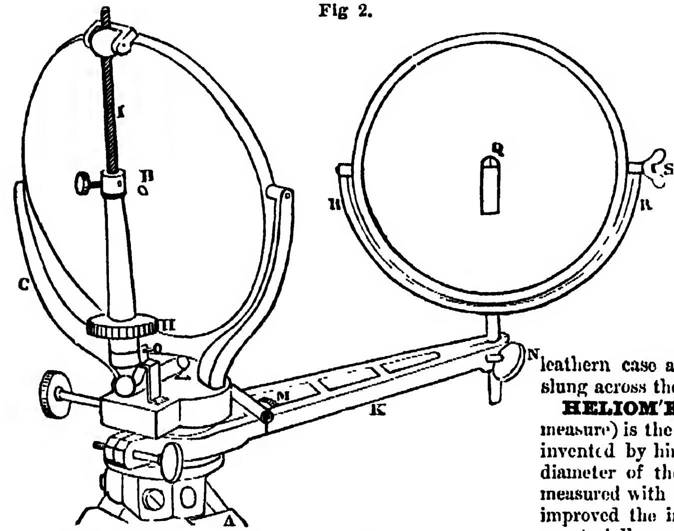


A, Tripod with cap; B, signalling mirror; C C, U frame for signalling mirror; D, tangent box; E, lever arm; F, spring; G, capstan-headed screw for regulating beat; H, key; I, vertical rod in socket; J, screw for clamping vertical rod; K K, jointed arm; L, clamping screw for jointed arm; M, clamping screw for hinge of jointed arm; N, clamping screw at end of jointed arm; O, double-jointed sighting rod; P, sighting vane with sighting spot and shadow spot.

tripod are jointed at the head so that each moves independently of and at any angle to the others. By this arrangement the instrument can be fixed as steady on the slope of a hill as on flat ground. The size of the mirror varies from a diameter of about 4 inches to one of a foot—the flash from a mirror of the latter size being so powerful as to practically give an unlimited range for all purposes of signalling. The mirror is so mounted as to have two movements—(1) a horizontal movement, by which it revolves, and can be made to face in any required direction. This is done by means of a tangent screw fixed under the plate on which the U-frame stands, and upon which the first finger and thumb of the left hand are constantly kept while signalling. (2) A vertical movement, which is obtained by screwing a steel rod, J, through a nut attached to the top of the mirror. On account of the apparent motion of the sun in the heavens the inclination of its rays

to the surface of the mirror imperceptibly changes every second, thus altering the direction of the flash. To keep the inclination the same throughout, the mirror must be slightly revolved every few minutes by means of the tangent screw, and be depressed or elevated by screwing the steel rod according as the sun gets higher or lower in the heavens. At the extremity of the steel rod a key or finger plate is adjusted, which works on a steel spring fixed to the upper plate. The depression of this key alters the vertical inclination of the mirror, and it is restored on the pressure being removed; a flash is thus thrown on and off the distant station. In order to insure the flash being truly directed a small portion of quicksilver is removed from the centre of the mirror, giving it the appearance of having a hole in it, while a metal vane or sighting rod fixed on a movable jointed arm running out from the head of the tripod is set up in front of the mirror at a distance of about 14 or 18 inches, on the top of which are marked a shadow and a sighting spot. To fix the flash on a distant station the mirror is placed roughly facing the sun

Fig 2.



Q, Duplex mirror with sighting spot; R, U-frame for duplex mirror; S, clamping screw for duplex mirror. Other reference letters same as in fig. 1.

and inclined towards it. The signaller then places himself in front of it with his back to the distant station, and moves his head and eye until he sees the reflection of the distant station in the exact centre of the mirror. The sighting vane is next shifted on its hinges until the reflection of the sighting spot is brought into line with the other two. The instrument is then sighted. This done, however much the mirror is revolved the alignment is never disturbed, inasmuch as the centre, being the axis on which it moves, remains stationary. The mirror is then slowly turned round until a small round shadow, caused by the hole above-mentioned, is brought across the vane, and the mirror depressed or elevated until the shadow exactly covers the shadow spot. When this is done the instrument is ready for use. The key then being depressed raises the shadow on to the sighting spot, and a flash is thrown on the distant station, and by varying the duration of the pressure the flashes are made long or short. By combining these long and short flashes, which are equivalent to the dashes and dots of the Morse telegraph code, the letters of the alphabet are indicated and the transmission of verbal messages is made practicable. Good signallers can send them at the rate of twelve or fifteen words per minute.

The preceding description of setting the instrument answers, however, only when the sun's position is between the two signalling stations. When the sun is in the rear of the transmitting station a second or duplex mirror (fig. 2), on which a small paper vane is gummed, is substituted for the metal vane. The setting of the instrument is now rather more complicated, but the principle is sufficiently simple when the single mirror is understood. The signalling mirror is now turned facing the sun and away from the other station, the duplex being turned towards the latter; care must be taken that they are clear of each other, so that the one may not intercept the rays of the sun nor the other intercept the flash to the distant station. The sighting is then proceeded with as when one mirror only is used. The signalling mirror then receives the rays of the sun and throws the flash on to the duplex, which in turn transmits the flash to the distant station.

Though the heliograph possesses advantages far superior to all other means of visual signalling, both on account of the speed with which messages can be sent and the practically unlimited distance of the receiving station, as well as its immunity from detection by an enemy, the instrument is rendered useless in the absence of sun, while the presence in the sky of even the smallest clouds may so considerably delay the transmission of messages as to render them practically useless in the field when received. Experiments have lately been tried in heliographing by moonlight with a partial degree of success. One man is sufficient to work an instrument, though in signalling three are the usual number allotted to economize the time in reading out and writing down messages. The whole instrument is packed in a portable leathern case and carried on a belt, while the tripod is slung across the shoulder.

HELIOM'ETER (Gr. *helios*, the sun; and *metron*, measure) is the name given by M. Bouguer to a micrometer invented by himself about 1745, by means of which the diameter of the sun, or any other heavenly body, may be measured with considerable accuracy. Fraunhofer greatly improved the instrument. The name is also given to the equatorially mounted micrometer executed at Munich in 1829 for the Königsberg Observatory. See MICROMETER.

HE'LIOSCOPE (a Greek term signifying literally sun-observer) is a kind of telescope adapted for making observations upon the sun without the eye being injured by the intense brightness of the solar rays. A coloured glass placed before the lens nearest to the eye in a telescope has long been the means used to prevent such injury.

HE'LIOSTAT (Gr. *helios*, the sun; and the root *sta*, to put or place) is the name given to an instrument employed in making optical experiments on the physical properties of light. The instrument consists of a plane metallic mirror, from the back of which projects a rod perpendicularly to its plane. The extremity of the rod is connected with the index of a clock, the plane of whose face is parallel to the equator; and as the index is turned by the wheelwork, the motion of the rod causes the mirror to turn about a vertical axis, and also about a horizontal axis, so that a pencil of the sun's light reflected from the mirror is always in the same position, and the diurnal motion of the sun is neutralized.

HE'LIOTROPE (Gr. *helios*, the sun; and *trepo*, I turn) is the name applied to jasper of a deep green colour, through which are scattered spots of a deep red colour; hence it is sometimes called BLOOD-STONE. As the stone is very hard it is much valued for seals, rings, &c. It takes a high polish and can be sharply cut. The name

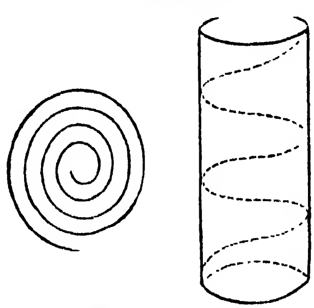
heliotrope is derived from the supposition of the stone turning the image of the sun to blood when reflected from it.

HELIOTRO'PIUM, a genus of plants belonging to the order BORAGINEÆ. *Heliotropium peruvianum* (Peruvian heliotrope or turnsole) is a shrub growing one or two feet high, and is much cultivated on account of the scent of its flowers, which resembles very much that of the vanilla. It is commonly known in gardens as cherry-flower. It is a native of Peru. *Heliotropium europæum* (the European turnsole or heliotrope) is a native of the south of Europe, the regions of the Caucasus, and North Africa. The flowers are white, but are not scented. *Heliotropium suaveolens*, a native of the country near the Caucasus, has sweet-scented flowers twice as large as Europæum. *Heliotropium villosum* is a native of Greece and of the islands of the Archipelago. It has large white corollas with a yellow throat. In this genus the style is terminal, generally short, with a stigmatic ring below the apex. The fruit splits up into four nuts. About 150 species of this genus have been enumerated. Some of them are used in large quantities by perfumers for their volatile oil.

HE'LIOTYPE, also called *Collotype* and *Lichtdruck*, is a photo-mechanical printing process strongly resembling lithography. It is based on the fact that when a film of gelatin impregnated with an alkaline dichromate is exposed to the action of light, it not only becomes insoluble in water, but loses its power of absorbing that fluid. A film or "skin" of gelatin having been prepared on a glass plate, it is sensitized by a solution of about 20 grains of potassium dichromate and 10 of chrome alum to the ounce of water. The chrome alum renders the film insoluble in water without destroying its powers of absorption. After the film is dry it is removed from its glass support and exposed to light under a "reversed" negative. By this means the shadows of the picture lose their power of absorbing water, the half-tones lose it partially, and the lights retain it. The film is then washed to remove the chemicals, attached to a metal plate with india-rubber solution, damped, and rolled up with a greasy ink like that used in lithography. This ink attaches itself to those parts of the film which are free from water, or comparatively so, and by using several inks of different strengths a greater range of tone is obtained. Impressions can then be printed on ordinary paper at a press or lithographic machine. In one modification of this process the gelatin film is used without detaching it from its glass support. The results are not equal in delicacy and gradation to silver prints, but being in ordinary printing ink are very permanent, and the process is well adapted for the reproduction of works of art in monochrome. Once the film is prepared for use, the printing can proceed quite independently of light, which is often of great advantage in our uncertain climate, while the cost is considerably less than that of silver printing, and the necessity of "mounting" the prints is avoided by printing directly on thick paper.

HELIOZO'A, an order of RHIZOPODA, contains the microscopic organisms commonly known as sun-animalcules. The Heliozoa are fresh-water organisms, found either free or more rarely attached by stalks to water plants. Like other Rhizopoda they are almost structureless, being composed of soft jelly-like protoplasm, provided usually with many nuclei and a contractile vesicle. They are globular in form, sending out portions of their substance in long delicate rays (*pseudopodia*), which, in addition to producing gentle locomotion, capture food and drag it down into the general mass. Most of the sun-animalcules are naked; but some (Acanthocystis) form round themselves a gelatinous coat in which are silicious spicules. One form (Clathrulina) has a globular silicious shell with large perforations, through which the pseudopodia project. Reproduction is usually by division: sometimes by the fusion of two individuals and the formation of spores. The best known form is the common sun-animalcule, *Actinophrys sol*. [See ACTINOPHRYS.] The largest of the Heliozoa is Actinosphærium, which is the size of a large pin-head.

HE'LIX, a spiral curve which is made by a line turning on the surface of a cylinder or of a cone, and continually advancing in the direction of the length of this imaginary cylinder or cone. The ordinary spiral spring is an example



True Spiral. Cylindrical Helix.

of such a curve in its cylindrical form. A true spiral, on the other hand, lies all in one plane, starting from a centre and gradually widening out as it proceeds in its path round that centre.

HELL. The awful conception of a place of everlasting torment for the spirits of evil men after death, where fire burns always without consuming, is not of any very great antiquity. The place of the departed, good and evil alike, among the Greeks (and probably among their masters in sacred things, the Egyptians also) was a place of shadows, where all brightness, all joy, and all that makes life worth living had departed—the shades of the good wandering aimlessly about in a state of "neither being nor not being" as it has been happily summed up, the bad suffering pains for their sins of a character suited to the sins committed. When Ulysses descended into Hades, the spirit of Achilles spoke to him and averred that he had rather be a slave on earth and earn his bread with hardship than be a prince among the immortal dead. The whole scene is imaged by Homer in cold colourless gray; nothing to hope or fear or care for, except a few memories of the vanished earth.

The Hebrew *Sheol*, which is translated sometimes *Hell* and sometimes *the Grave* in our Authorized Version of the Bible, was still more lost to all sense of life or being than the Greek Hades. In Sheol the bodies of the dead, or their shades, lay about in the gloom, motionless, thoughtless, silent (Psalm xciv. 17), the good unrewarded, the evil unpunished: "there is one event to the righteous and to the wicked" (Eccles. ix. 2). It was even doubted whether the power of God extended there, or whether at death the Jew did not pass away from among the children of God to become the subject of the King of Terrors. For, says the author of Ecclesiastes (ix.), "Every man goes to join the dead. For who is there that escapes? While there is life there is hope; and a living dog is better than a dead lion." The close parallel with Homer here is very noteworthy. He proceeds:—"The living know they will die, but the dead know nothing at all. And they have no reward any more, for the memory of them has perished." Still more explicit is the noble-minded author of Psalm lxxxviii. 5, who cries to God that he is in his despair "like the slain that lie in the grave, whom thou rememberest no more, and they are cut off from thy hand." In Job x. 22, Sheol is described emphatically as a "land of darkness, as darkness itself," or as it may be more accurately translated,

"A land of darkness and deathlike shade,
A land as black as night,
Where all is pitch dark and without order,
And the noonday as black as the night."

But about the time of Christ, or shortly before, this view of the under-world—as a vast, gloomy, noiseless, rigid prison—yielded to more vivid and in many senses more elevated conceptions. First it was believed that there would be a resurrection, when the faithful would receive their life back, though the sinners would remain in Sheol; and this view may be traced in the later Psalms and in the Second Book of Maccabees (vii. 14, &c.) Then it was felt that God's providence must extend into the abodes of the departed, and places for the good and for the bad were imaged to exist in Sheol, in the manner depicted in the Book of Enoch (xxii.), these places being separated by a chasm and by water. "Between us and you there is a great gulf fixed," Abraham says to the rich man in hell in the parable (Luke xvi.) It is in Enoch, the uncanonical book, of the first or at most the second century B.C., which Jude, however, quotes (Epistle of Jude, 14) as authentic, and which has in our own time been fortunately discovered in an Ethiopic translation, that the idea of everlasting torment in Sheol is first expressed. Now the valley of Gehenna (Hebrew *Ge-ben-hinnom*, or valley of the sons of Hinnom, Hinnom being some ancient proprietor probably), lying to the south and west of Jerusalem, was the common place for the refuse of the city, filled with dust-heaps and rubbish of all kinds. The south-east of it was called Tophet (place of burning), and had been anciently used as an altar of idolatrous fire-worship, which is why the valley was allowed to be defiled in the way described. The constant corruption made Gehenna sickening to every sense, and parasites of all kinds bred in the festering horrors of it. From time to time the heaps of rubbish would be set on fire, and the fires of Tophet flamed in another sense, now here and now there, continually. The most abhorred punishments therefore took their symbol from Gehenna, where (Mark ix. 48) "their worm dieth not and the fire is not quenched." It was in this place that Enoch was made to declare, in the book bearing his name, that there lay one of the mouths of hell. He mapped out the under-world, using Gehenna as his model, with almost the fulness and accuracy of Dante. But while this horror of a putrid and burning rubbish heap was poetized and intensified into the awful conception of the hell of the ungodly, the old conception of paradise was used again to provide a home for the blest, a restored Eden, to which the children of the banished Adam might eventually return.

It is right, however, to add that the Jewish rabbis of our day declare their predecessors of early Christian or closely pre-Christian times not to have believed in the *eternity* of the torments of Gehenna, but to have held a view remarkably resembling in some points the purgatory of Roman Catholicism—namely, that it was a state of pain and torment never ceasing, but not destined to be everlasting, and therefore a state not without hope. They are also able to quote largely in support of the claim which many make that the true view of the great rabbis as to the fire of hell was that it was not a material fire, but the flames of an intense remorse, which would eventually, through unimaginable tortures, burn away sin from the heart. This non-materiality of the flames of hell is also the teaching of the Greek Church on the subject, and constitutes one of the points of difference between it and the Church of Rome.

This purifying fire was in early Christian times made the foundation of a belief in a middle state between paradise and hell by the Latin Christians under the form of purgatory. The definition of this belief may be traced to St. Augustine, but it was St. Gregory the Great who finally formulated the dogma. Here we are in one particular far enough away from the purifying fire of the rabbis, supposing the modern interpretation of their views to be the true one; for in the Roman Catholic view the bad are at once damned, and their spirits sink into the everlasting flames of hell, while the good alone enter the fire of purgatory, and pass through it, with tortures varying with each soul according to the extent to which that soul is defiled by the evil which defiles every man, before attaining to the paradise which is their goal.

The views formerly held with respect to the material fires of hell have been very much modified in recent years, and the ideas now generally entertained by orthodox Christians may perhaps best be described in an extract from the address of Dr. Parker, president of the Congregational Union of England and Wales, for 1884:—"One view of human immortality is this: the soul as such is immortal; in bliss or woe it must spend eternity; the believing and pardoned soul will be for ever with the Lord, serving him amidst the glory of eternal light; the impenitent and unpardoned soul will exist for ever in outer darkness, without mitigation of agony, without offer of release, without opportunity and without desire to pray—'men shall seek death, and shall not find it; and shall desire to die, and death shall flee from them' (Rev. ix. 9). Another view is this: eternal life is the gift of God; Christ only hath life in himself, and that life is imparted to the souls that receive his gospel and enter into fellowship with him—'Whosoever liveth and believeth in him shall never die;' 'life and immortality are brought to light in the gospel;' the wicked shall be punished in the world to come, and shall eventually perish in their own corruption—'the soul that sinneth, it shall die;' 'the wages of sin is death;' the adversaries of the Lord shall be utterly consumed, and everlasting destruction shall be their lot. A third view is this: God will eventually save the whole human race; though men die impenitently, God's grace, ever greater than man's sin, will follow them, and how long soever and tremendous the struggle Christ will ultimately triumph, and every soul of man will shine as a star in his glorious crown. These three views are each taken by some of the most enlightened Christian thinkers, and are all said to be supported by distinct scriptural teaching."

HEL'LAS, HELLE'NIC. See GREECE; GREEK.

HELL'BENDER (*Menopoma alleghaniensis*) is the formidable name of a North American amphibian belonging to the order URODELA. The hellbender is usually about 18 inches in length, but specimens have been found 2 feet long. It is of a pale slate colour, mottled with black. The head is large, flat, and broad, and the mouth wide and covered with thick fleshy lips. It has a stout, thick, subcylindrical body, and a large, laterally compressed tail. The neck is contracted, and there is a single gill-slit on each side. The tongue is thin and flat, free in front and at the sides. It has very small nostrils, placed close together, and minute black eyes. The legs are short and thick, and broadly fringed on the outer edge. The toes, which are four in number on the front feet and five on the hinder pair, are short, webbed, and without claws. The hellbender is found in the Allegheny River and its tributaries, and no doubt inhabits also many of the branches of the Ohio and Mississippi rivers. It lives entirely in the water, and is very voracious. It feeds on fish, worms, and molluscs, and indeed nothing that it can devour is spared by it. The fishermen dread it very much, and believe it to be poisonous.

HEL'LE, a personage of the Greek mythology, was the sister of Phrixos. When Helle and her brother fled from their cruel stepmother, Hermes lent them the golden ram, which had the power of flight, to take them across into Asia. Helle was unfortunate enough to fall off half-way across, and was drowned in the strait called after her the *Hellespont*. Her brother escaped safely.

HEL'LEBORE, a genus of plants belonging to the order RANUNCULACEÆ. *Helleborus niger* (black hellebore or Christmas rose) is a perennial herb with a black branched knotty underground stem (rhizome), pale green

pedate leaves, and large whitish flowers. The floral leaves, which have the appearance of petals, are in fact sepals, five in number, at first white with a pink tinge, afterwards becoming greenish. The petals are quite small, shorter than the stamens, tubular, with a two-lipped opening. The stamens are numerous, hypogynous. There are five to eight free carpels, ripening into follicles with several seeds. It is a native of southern and eastern Europe. The rhizome and roots which spring from it are imported from Germany under the name of "black hellebore root." It is used as a drastic hydragogue cathartic, and also as an emmenagogue and anthelmintic. Though of great repute with the ancients, and still used in the United States, it has fallen out of use in Great Britain, except for domestic animals. Black hellebore root is adulterated with the rhizome of baneberry (*Actæa spicata*), but this can be distinguished, on taking a cross section, by the central woody portion being divided in a radiate manner, whereas this is but very slightly divided in hellebore. The hellebore of the ancients, which Melampus used to cure the daughters of Prœtus, king of Argos, was probably *Helleborus orientalis*.

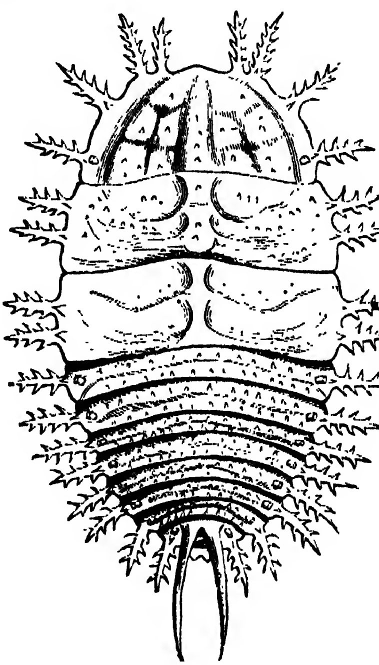
The Christmas Rose, so called from its flowering in December, has always been a favourite in gardens. *Helleborus colchicus* is the finest of the red or crimson species, the flowers of this variety deepening to a dark purple; the leaves are dark green, with five to seven divisions, and the veins of the young leaves of a dark purple colour. *Helleborus olympicus* is a handsome species, and is well adapted for growing in cities. The flowers are rose-coloured, and appear in spring together with the leaves. There are two British species, *Helleborus fœtidus* (stinking hellebore) and *Helleborus viridis* (green hellebore or bear's foot). For white hellebore see VERATRUM.

HEL'LENIST, a name sometimes given to scholars who are proficient in the language and literature of ancient Greece. More particularly, however, it is applied in the New Testament and in Jewish history to those Jews who by settling in foreign countries had adopted the common Greek dialect and many of the forms of Greek civilization. It includes most probably proselytes gathered from the Greeks and from other nations, but it is applied specially to such as were of purely Jewish parentage and origin. At the period of the commencement of the Christian era the Jews were dispersed all over the Roman Empire, throughout which the Greek language had gained a general currency, and was spoken everywhere by educated men. Hence there were even in Jerusalem itself synagogues for Greek-speaking Jews, though the strict national party hated both Greek language and literature. The chief centre of the Græco-Jewish culture was at Alexandria, and it is to that city that the formation of the peculiar dialect of the Greek language known as the Hellenistic must be traced. The members of the Jewish colony in Egypt, though they spoke the Greek language, were still, so far as their inner character was concerned, essentially Jews, and hence the Hebrew and Aramaic forms and idioms found in the Hellenistic dialect. The most important memorial of this language is found in the Septuagint version of the Old Testament.

HEL'LESPONT. See DARDANELLES.

HELM, the steering apparatus of a ship, consisting of the rudder and the tiller or wheel. The rudder is the part acting directly on the water, and serves to govern the ship's motion; for, on being turned so that its plane is in a position oblique to the plane of the masts and keel, the reaction of the water against it, as the ship advances, being resolved in a direction perpendicular to the last-mentioned plane, becomes a force which causes a ship to turn upon a line passing through its centre of gravity. The tiller is a lever, formed into a handle, for multiplying the power exerted on the rudder. The wheel moves the rudder from side to side by means of ropes or chains, still further multiplying the power of the leverage. In small vessels and barges the tiller and not the wheel is used.

HELMET-BEETLE is the name given to the beetles of the family Cassididæ, belonging to the group PHYTOPHAGA. The helmet-beetles present a singular appearance, as their bodies are flattened and the thorax and elytra expanded laterally, so as to cover the head and trunk with a large helmet and shield. The species of this family are distinguished by their having the antennæ rather short, thread-like, or slightly thickened towards the apex, placed on the anterior part of the head, and almost close together. The legs are short and contractile; the tarsi are flattened, soft, and velvet-like beneath; the penultimate joint bi-lobed, the lobes completely inclosing the terminal joint. These



Larva of *Cassida rubiginosa*.

beetles live on the leaves of plants. Their larvæ shelter themselves under an umbrella of their own excrement, and this covering they can elevate or depress in such a way as to shade or shelter them more or less effectually. They effect this by means of a forked process of the tail, on which they place the excrementitious matter. It is sometimes turned up and lies flat on the back; sometimes it forms an acute, sometimes a blunt angle with the body; at others it is unbent and in the same direction with it. Many of the exotic species of this large family are adorned with the most vivid golden hues. Thirteen species of the genus Cassida are found in England on thistles and other plants, the commonest of which is the Tortoise Beetle (*Cassida viridis*).

HELMETS, ancient armour of defence for the head, still worn by the officers and soldiers of some of our cavalry regiments. As a part of defensive armour, the helmet is of high antiquity; some sort of covering of this description for the head appears to have been worn by the warriors of every country. Helmets were found even among the inhabitants of the South Sea Islands when discovered by Captain Cook. It does not appear that the Greek or

Roman helmet usually protected the face. Among the varieties which in the middle ages had separate names we find the 'chapelle-de-fer, the basinet, the burgonet, the castle, the hufken, the morion, the salade, and the skull. These were almost invariably of steel. There was also the jousting helmet, used in tournaments, which was sometimes of leather.

Firemen of the present day wear a heavy headpiece of brass, to protect them as far as possible from falling ruins at conflagrations. The police have of late years been supplied with a somewhat similar covering for the head, but constructed merely of felt, and in 1878 this was introduced into the British army. In India and other hot climates helmets of pith or white felt, with the additional screen of rolls of white linen, are worn as a protection from the rays of the sun.

As ornaments over the shield or coat of arms, helmets are still used in heraldry. The full-faced helmet with six bars, all of gold, damasked, is for the sovereign and princes of the blood; the full-faced helmet of steel, for marquises and dukes; earls, viscounts, and barons have a profile or side-standing helmet of steel ornamented with bars; the full-faced helmet of steel, with the visor or beaver open, is for baronets and knights; the profile helmet, steel, with the visor closed, for an esquire.

HELMET-SHELL (Cassis) is a genus of GASTEROPODA belonging to the family Doliidæ. The shell is ventricose, somewhat globular, with the whorls adorned with irregular ridges (varices); it has a short, nearly flat spire, a long aperture, the outer lip of which is thick, reflected, and toothed within, the inner spread over the body whorl, callous, and plaited; the canal is sharply recurved; the operculum is oblong, narrow, and small; the foot is largely dilated. The animals are active and voracious. They live

Red Helmet-shell or Bull's Mouth (*Cassis rufa*).

in shallow water in sandy localities, often concealing themselves in the sand, and attacking the bivalve shells tha abound in such places. They are found in all tropica seas; thirty-seven species have been described. The comprise many of the largest known Gasteropoda. Th shells of some of the larger species are extensively used i the manufacture of cameos. Like most other shells the are composed of three layers or plates, and these diffe from each other in relative thickness as well as in colour. The central plate is generally the thickest, and is differently coloured from the outer. The cameo cutters appear to b well aware of this structure in the helmet-shells and som others, and avail themselves of it in cutting their cameo so as to produce white or rose-coloured, &c., figures on a dark ground. In the economic collection of shells in th British Museum, for instance, may be seen cameos carved n the shell of the Horned Helmet-shell (*Cassis cornuta*), showing white figures on an orange ground; on the Black Helmet-shell or Queen-conch (*Cassis madagascariensis*); and on *Cassis tuberosa*, showing white on dark claret colour; and on the Red Helmet-shell or Bull's Mouth (*Cassis rufa*), from the Indian seas, which is the shell most extensively used, showing pale salmon colour on orange ground.

HELODER'MA is a genus of lizards (Lacertilia) belonging to the family Monitoridæ. This genus includes two species, which enjoy the reputation of being the only poisonous lizards known to science. These lizards are peculiar to Mexico and the surrounding regions. *Heloderma horridum* is a large lizard, about 15 inches in length, with the head and body covered with large convex scales. The body is of a pale yellow colour, ornamented with irregular dark-brown lines, which on the tail form rings. The tail is long, the legs short, and the tongue broad and bifid. The teeth are grooved like the fangs of poisonous serpents. This lizard has also highly developed salivary glands, which, issuing at the bases of the teeth, carry the poisonous saliva into the grooves. The bite of the lizard is fatal to small mammals and birds, and highly injurious to man, though not deadly. The second species, *Heloderma suspectum*, a fine specimen of which may be seen in the gardens of the Zoological Society, shares in this poisonous character. This lizard is not unattractive in appearance, being covered with jet black and orange scales. In captivity it prefers eggs to any other kind of food, though it will eat rats and such small mammals. The Indians of Central Mexico worship the Heloderma as an incarnation of one of their deities.

HELOISE. See ABELARD.

HEL'OTS. The helots of Sparta formed an institution almost unique in antiquity, and paralleled perhaps more nearly by the Russian serfs before their emancipation by Alexander II. than by any others in our own times. They were distinctly not slaves, though helots might degenerate into slaves in the towns; they were the free rustic population living in their own villages, always clad in leather cap and sheepskin, and almost as strictly bound to the soil as the trees that grew in their birthplace. Undoubtedly the Dorians, at the period of their conquest of the south-east part of the Peloponnesus, finding the original population too numerous to enslave and themselves too few to undertake the cultivation of so large a territory, hit upon this plan of helotism. The word helot, from its etymology, means "captive;" but it quickly came to mean far otherwise. The helot, with his wife and family, his home and his class associations, and with the power of acquiring property to a limited extent, had not an unhappy lot at all. A not very distant parallel might be found in Ireland before the Gladstone land laws came into force. Here the peasantry were practically, as the helots were by law, tied to the soil; and here, too, they were free men, though reduced to a very dependent state by the crushing force of heavy rent, the exact position of the helot with his absentee "proprietor," who lived in Sparta, and received the produce of the helot's toil. The state considered the helots as state property, and used them without restraint for military operations, freeing them not uncommonly as a reward for prowess in battle. Cleomenes III. being in straits for money, offered freedom to all helots who could pay five Attic minæ (over £20). He received no less than 500 talents by this means (worth nearly £122,000), so that not less than 6000 helots were in a very well-to-do position. But that was late in Greek history. The early state of the helots was humble. Many were glad to accept menial duties. The state did not disapprove of forcing them to public degradation, as when they were made drunken at certain festivals in order to disgust the Spartan youths against intoxication.

From time to time as the helots awoke from their slave-like debasement, the Spartans grew afraid of their rising. When they went to war special precautions were always observed to guard against a rising. It was a perpetual terror before their eyes. Consequently we are not surprised, coupling this with the cruelty which Spartans regarded as a virtue, when we read the dark story in Thucydides of an event of his own time. In the eighth year of the Peloponnesian War (B.C. 424), the ephors desired all helots who had distinguished themselves to apply for a reward, stating their services. Numbers came forward, 2000 were approved, formally freed, crowned with garlands amidst general rejoicings, and then *disappeared* to a man; how, was never known (Thucyd. iv. 20). Plutarch, describing the Spartan *krupteia*, or secret police, among the helots, says that Lycurgus decreed that war should be formally proclaimed every year against the helots, so that any one who killed a helot should not be liable for murder. This is unsupported and seems fantastical; the *krupteia* were probably simply the widespread agency of an irresponsible secret and cruel oligarchy, like a Venetian Council of Ten magnified and intensified.

In 464 B.C. the long-felt fears were realized. Cheered by the portent of an earthquake, the helots rose against the thinning ranks of their masters, worn down by many wars. They were within an ace of seizing Sparta itself, but being foiled in that design by the young king Archidamas, they turned upon Ithomê, which they successfully held against a long Spartan siege covering several years. They were not subdued until the Spartans had called upon all Greece for help, the Athenians alone sending 4000 men. The Athenian contingent was not long retained, for Sparta's jealousy of Athens was too great. It was not till B.C. 455 that the helots offered to capitulate on condition of emigration, and on acceptance of their terms all who had taken part in the revolt were sent to Naupactus. Later on, when Brasidas was covering the Spartan name with glory in Thrace, the citizens dreaded that the return of the large body of helots, flushed with success and trained under the first military genius of the time, would lead to a new outbreak. They took prompt measures against it. The whole of the helots in that army were planted in a colony, and never saw their homes again.

Therefore when Epaminondas, the last of the great warriors of ancient Greece, set up the supremacy of Thebes in 370 B.C., and advanced against Sparta, now become the common enemy, the Spartan power crumbled before him, undermined on every side by the warm welcome the helots gave to the invaders. After the fall of Sparta Epaminondas founded two new states with large bodies of these enfranchised helots—the state of Messene and that of Megalopolis—in the centre of Arcadia. Many of them were Messenians of as good lineage by origin as the Spartans themselves, all were Greek with Greek traditions, language, and aspirations, aspirations about to be realized after centuries of serfage, if only the barbaric supremacy of Macedon had not almost all at once begun, and by destroying the independence of Greece prepared the way for the grinding tyranny of Rome, so soon to follow.

HELPS, SIR ARTHUR, K.C.B., D.C.L., essayist and historian, was born in 1817. He was educated at Trinity College, Cambridge, where he graduated B.A. in 1835. After leaving college he entered the public service as private secretary to Mr. Spring Rice (afterwards Lord Monteagle), then chancellor of the exchequer in Lord Melbourne's administration. When Mr. Spring Rice in 1839 accepted the permanent and non-political office of comptroller of the exchequer, Mr. Helps became private secretary to Lord Morpeth, at that time chief secretary for Ireland, and afterwards Earl of Carlisle and lord lieutenant. He also held the office of commissioner of French, Danish, and Spanish claims. On the downfall of the Melbourne ministry Mr. Helps withdrew from the official arena to rural seclusion and studious leisure on a small estate of his own in Hampshire. On the retirement of the Hon. W. L. Bathurst from the clerkship of the Privy Council Mr. Helps was appointed his successor in 1860, and continued to fill that situation till his death, 7th March, 1875, at the age of fifty-eight.

Mr. Helps' earliest work, entitled "Thoughts in the Cloister and the Crowd," was published in 1835, when he quitted Cambridge. Like all his works, with one exception, it was issued anonymously. "Essays Written in the Interval of Business," a little volume displaying both intimate knowledge of the world and careful self-culture, appeared in 1841. Two years later it was followed by two dramas, "Catherine Douglas, a Tragedy," and "King Henry the Second, an Historical Drama." In 1845 Mr. Helps grappled genially yet earnestly with a delicate and difficult social problem in "The Claims of Labour; an Essay on the Duties of the Employer to the Employed, to which is added an Essay on the Means of Improving the Health, &c., of the Labouring Classes." In 1847 appeared "Friends in Council," in which Mr. Helps discussed a wider range of topics, and by the use of the dialogue-form gave a dramatic liveliness to the expression of his practical and suggestive thoughts on men and things. "Companions of my Solitude," published in 1851, may be regarded as a sequel to "Friends in Council," and of all his works gives the most direct and complete view of his own character. It grew out of an intense realization of the misery entailed by the particular sin which it so powerfully denounces. His remarks, which are very frequent, on the relation between men and women, and on love, and the office of love in forming the human character, are characterized by remarkable purity and chivalry. A second series of "Friends in Council" was given to the world in 1859. These works, as well as his "Brevia" and "Thoughts on Culture," are not intended, as some seem to suppose, for the cultivated classes only; but, as Mr. Charles Kingsley has justly said, "would furnish to the poorest as well as to the richest reader many a weighty and welcome lesson concerning himself, his family, his countrymen, his country, and his duty to them all. He grounds his sayings wherever he can on truths which are equally intelligible to, because equally true for, all men. His aphorisms, even on government, would stand good just as much for the grocer and his shopboy as for the statesman and his subordinate."

The question of slavery had an overpowering interest for Mr. Helps, and in order to treat it in an exhaustive as well as in an attractive manner in connection with South America, he mastered the Spanish language, visited Simancas, and collected and digested an immense mass of MSS. His elaborate work on the subject was undertaken from no ambition to win for himself high historical reputation, but out of an intense abhorrence of slavery. "The Conquerors of the New World and their Bondsmen" was published in 1848. Recast and expanded, the work reappeared in 1855 as "The Spanish Conquest in America and its Relations to the History of Slavery and the Government of Colonies." Volume iv., completing the work, was published in 1861. From the same deep interest in slavery sprang the drama of "Oulita the Serf," published in 1858. The other works of Mr. Helps are: "The Life of Pizarro, with some account of his Associates in the Conquest of Peru," in 1869; "Cassimer Maremma," in two vols.; and "Brevia, or Short Essays and Aphorisms," in 1870; "Conversations on War and General Culture;" "The Life of Hernando Cortes" and the "Conquest of Mexico," two vols., and "Thoughts upon Government," in 1871.

The works of Sir Arthur Helps were the reflections of his own thoughtful, amiable, and generous character. His analytical faculty was remarkably powerful, and had been sharpened by long converse with the world. But he

analyzed human nature, not for the purpose of proving how vile it is, or to support any preconceived theory, but to show how tolerable, even lovable, it is after all, and how much more tolerable and lovable it might become by the exercise of a little common sense and charity. He had something to say for the worst cause and, which is less common, because more difficult, for the worst man. His ruling motive, as his friend Mr. Hullah said, through all the long years of activity, both in thought and deed, was benevolence, grounded on belief, not in the perfectability of humanity, but in the infinite capability for improvement of human life. This was observable in his conversation as well as in his writings, and especially in his habits and schemes. His belief in the possibility of a better state of things in this world, and his efforts to bring this about, were not limited in their aim and operation to the human race; they extended to every living thing. He was not at all a good hater, but he hated cruelty with "a perfect hatred." His efforts to lessen it were not confined to his writings; they found vent in much vigorous and successful action. The arrangements, for example, now made for the transmission of cattle by railway, not only in England, but over the whole Continent, were inaugurated at his instigation and completed through his perseverance. Sir Arthur Helps was one of the most loyal because most sincere of friends. His cordial assistance and counsels were always ready for those who had any claim upon him. As an acknowledgment of his public services, as well as of the personal aid he had rendered to her Majesty, he received from her the honour of knighthood in 1872, and his Alma Mater conferred on him the degree of D.C.L. In a notice of his death which appeared in the *Court Circular*, it was said, "By the death of Sir Arthur Helps the queen has sustained a loss which has caused her Majesty great affliction. As a loyal subject and as a kind friend he rendered to her Majesty very important service. He assisted, with a delicacy of feeling and an amount of sympathy which her Majesty can never forget, in the publication of her records of the Prince Consort's speeches, and of her 'Life in the Highlands,' to which he willingly devoted the power of his enlightened and accomplished mind. The queen feels that in him she has lost a true and devoted friend."

HEL'SINGFORS, the capital of Finland, in the government of Nyland, is situated on a peninsula of the Gulf of Finland, 274 miles west of St. Petersburg by rail, and has a population of about 45,000. It has a fine harbour, which is strongly defended by several forts. Among these is the citadel of Sveaborg, which was bombarded for two days and nights by the English and French fleets during the Russian War, in 1855, without making any material impression. The town also possesses a senate-house, observatory, numerous charitable and educational institutions, a university, with a library of about 80,000 volumes, and various museums. It is the see of the Lutheran Archbishop of Finland, and has considerable trade in timber, corn, and fish, and manufactures of sailcloth, linen, porcelain, sugar, and tobacco.

HELS'TON is a municipal borough of England, in the county of Cornwall, situated on the east bank of the small river Loe, or Looe, about 2½ miles from the sea, 10 miles W.S.W. of Falmouth, and by rail 318 miles from London. The town is built at the head of a pretty valley opening to the sea, and has a neat and clean appearance. It is in the centre of an extensive agricultural and mining district. The chief buildings are the church, a modern edifice, the town hall, grammar-school and several places of worship for dissenters. Iron, coal and timber for the use of the mines are imported in large quantities at Port Leven, about 3 miles distant. The May games, or *Floralia*, once general throughout England, are still kept up here; and on the 8th of May, a general holiday, floral processions and dances are held. The borough is governed by four aldermen and twelve councillors. From 1832 to 1885 it returned one member to Parliament, but in the latter year ceased to be a parliamentary borough. Helston had 7935 inhabitants in 1881.

HELVEL'LYN, a mountain of England, on the borders of Westmorland and Cumberland, breaking down east towards Ullswater in steep, rocky declivities, and bounded west by the vales of Grasmere and Thirlmere, the pass between which, called Dunmail Raise, is 720 feet high; it has an elevation of 3055 feet. The rock is one peculiar to the Lake district; it is a green slate, extensively pervaded and altered by porphyry.

HELVET'IC ALPS. See ALPS.

HELVET'II, an ancient, powerful, and warlike Celtic nation, occupying much of what is now called Switzerland, and both banks of the Rhine from Basel to Constance. Their country was never called Helvetia, though this is the modern Latin designation of Switzerland. It was always Ager Helveticus or Helvetiorum. As the Helvetii did not anywhere touch the Roman boundary they long remained at peace with Rome; but in 113 B.C. a German nation called the Cimbri (not by any means to be confused with Celtic Cymry), having been much harassed, determined to pass into Gaul, and peacefully crossed Helvetic territory for that purpose. The Celtic Helvetii soon made common cause with their German visitors, and when the wave of the Cimbri had broken against the Pyrenees, had recoiled upon Northern Gaul, and had been driven southwards by the brave Belgæ, a considerable part of the Helvetii and another German nation called Teutones joined them, and all poured into Southern Gaul together (102 B.C.) They were met by the great Marius, who first annihilated the Teutones at Aquæ Sextiæ (Aix in Provence), and then the Cimbri, who had reached Italian Gaul meanwhile, at Vercellæ. The Helvetii held together, and the bulk of them escaped over the Alps. Some forty years later the Helvetii, who now numbered 368,000 without counting slaves, suffered severely not only from over-population, but from pressure by the Germans, and they determined upon a westward migration into Gaul. They burned their towns and villages to prevent all possibility of retreat, and loading all their property on waggons they arrived, an entire nation without a home, on the shores of Lake Leman, in March, 58 B.C. Julius Cæsar, who had just been appointed governor of Gaul, gained time by negotiations to break down the Rhone bridges and to erect a great earthwork to defend any crossing south of Lake Leman. The Helvetii, foiled in this route, determined to go round the lake and to pass through the Jura and across the Saone. This would bring them into the territory of the Hædui. Cæsar waited only to bring up reinforcements from Italy, and then followed them. He caught them up while part of the host was yet on the left bank of the Saone, utterly crushed this part of his foes, and dashed across the river into Gaul in pursuit of the rest. Both bodies moved northwards, a day or two's march apart. Cæsar found no opportunity for an attack; but upon his stopping to possess himself of Bibracte (now Autun), capital of the Hædui, the Helvetii thought he had turned back for fear of being led so far among wild barbarians, and attacked him, in hope of profiting by his fears. A very severe engagement resulted in a terribly hard-won victory for the Romans. The Helvetii were able to retreat, but no one would afford them settlement from terror of the Roman arms. Cæsar was soon strong enough to order them back to their old lands, whither therefore the remnant, about a third of those who had started out, returned. They frankly accepted the position, much as their congeners in Britain, and became thoroughly Romanized. In 70 A.D. they refused to recognize the usurper Vitellius as emperor, and were dealt with with great severity. They became gradually merged in the great mixture of races which filled their mountains, but it is no doubt to them that the fundamental

characteristics of the Swiss are to be ascribed. Their plan of dividing into cantons instead of governing by means of great cities and their dependencies, and the individuality of these cantons, except upon strictly national concerns, is substantially the scheme of government under which their descendants of to-day still live.

HELVET'IUS, CLAUDE ADRIEN, was born at Paris in January, 1715, and was educated at the Jesuits' College of Louis le Grand. Having passed through a course of legal study, Helvetius obtained the lucrative appointment of *fermier-général*, through the influence of the queen, Marie Leczinska, to whom his father was physician; but disgusted with the oppressive nature of its duties, he resigned this situation, and purchased that of chamberlain to the queen's household. At this period Helvetius led a disorderly life, and vanity was a conspicuous feature in his character. But he was as kind-hearted as he was vain, and an act of beneficence was as dear to him for its own sake as the applause which he courted so eagerly.

In 1751 Helvetius married the beautiful and accomplished daughter of the Comte de Ligneville. From this time he lived chiefly in retirement at Voré, enjoying with his wife and children the pleasures of domestic life, and ameliorating the condition of his tenants and vassals. In 1758 he published the treatise "De l'Esprit," which was denounced by the court and the Jesuits as dangerous to society and to religion. To regain the favour of the court Helvetius published three letters of apology. Notwithstanding his confession of a Christian faith, and his disclaimer of all opinions inconsistent with its spirit, the doctors of the Sorbonne drew up a formal condemnation of the work; and it was publicly burned, according to a decree of the Parliament of Paris. The style of the work is vicious and declamatory, but the argument is well sustained, and enforced by great felicity and copiousness of illustration. In 1764 Helvetius visited England. He died at Paris, 26th December, 1771, leaving behind him a work entitled "De l'Homme, de ses Facultés et de son Education," which was published the same year at London by Prince Gallitzin. This treatise, which may be considered as a continuation of and commentary upon his earlier philosophical work, is vastly superior to it in style.

HEM'ANS, FELICIA DOROTHEA, an English poetess, was born 25th September, 1794, at Liverpool, where her father, whose name was Browne, was engaged in mercantile pursuits. He was a native of Ireland; her mother was an Englishwoman, but was descended from a Venetian family through her father, who was the commercial agent at Liverpool for the Venetian government. About the year 1800 Mr. Browne, in consequence of the failure of the mercantile concern, removed his family from Liverpool to an old mansion, spacious and solitary, called Grwych, not far from Abergele, in Denbighshire, North Wales. Mr. Browne died not long afterwards. Felicia Browne began to write poetry before she was nine years of age. Her first volume of poems was published in 1808, and contains some verses written by her as early as 1803 or 1804. A harsh review of this little volume affected her so much that she was confined to her bed for several days. Her second volume, "The Domestic Affections," was published in 1812.

In 1812 Miss Browne became the wife of Captain Hemans, of the 4th Regiment. His constitution had suffered so severely in the retreat upon Corunna, and subsequently by fever caught in the disastrous Walcheren expedition, that he felt it necessary, a few years after their marriage, to reside in Italy. This at least is the motive assigned for his leaving his wife; but their union, it is said, was not happy, and this separation, which took place just before the birth of her fifth son, closed it for ever. Mrs. Hemans, with her five sons, went to reside with her mother, then living at Bronwylfa, near St. Asaph, in North Wales.

Mrs. Hemans now resumed her literary and poetical pursuits with increased ardour. She studied the Latin, Italian, Spanish, Portuguese, and German languages. She made translations from Horace, Herrera, and Camöens, and contributed a series of papers on foreign literature to the *Edinburgh Magazine*. "The Restoration of the Works of Art to Italy" was published in 1815; "Tales and Historic Scenes," in 1819; and, about the same time, "The Sceptic," a didactic poem, in heroic rhyme; and "Modern Greece," in ten-line stanzas. Her poem of "Dartmoor" obtained the prize from the Royal Society of Literature in 1821. Her tragedy, "The Vespers of Palermo," was represented at Covent Garden Theatre in 1823. It was unsuccessful there, but was afterwards better received at Edinburgh, when Sir Walter Scott wrote an epilogue for it. "The Siege of Valencia," "The Last Constantine," and other poems, were published in 1823.

In 1825 Mrs. Hemans removed, with her mother, her sister, and her sons, to Rhyllon, near St. Asaph. Her sister had returned in 1821 from Germany, where one of her brothers was attached to the Vienna embassy, bringing with her a fresh supply of German books, and Mrs. Hemans' delight in German literature may be dated from that time. Her "Lays of many Lands," most of which appeared in the *New Monthly Magazine*, then edited by Thomas Campbell, were suggested by Herder's "Stimmen der Völker in Liedern," and, preceded by "The Forest Sanctuary," formed her next volume, published in 1827. This was followed, in 1828, by the "Records of Woman," and in 1830 she published "The Songs of the Affections."

The latter months of 1833 were busily spent in arranging and preparing for publication the three collections of her poems which were published in the spring and summer of 1834: "Hymns for Childhood;" "National Lyrics and Songs for Music;" and "Scenes and Hymns of Life." She died 16th May, 1835, and was buried in St. Anne's Church, Dawson Street, Dublin. A volume of "Poetical Remains" was published after her death.

HEM'ATITE or **HÆM'ATITE** (Gr. *haima*, blood) is the name applied to reniform granular or amorphous sesquioxide of iron (Fe_2O_3). In its crystallized form it is known as "specular iron" (Lat. *speculum*, a mirror), from its bright glistening lustre, which when foliated or micaceous gives rise to the subvariety "micaceous iron." Hematite is a valuable ore of iron, but it always contains more or less earthy matter: it has a hardness of about 5·5 or 6·5, and specific gravity 4·5 to 5·3, and in powder has a red colour. Several varieties are recognized: *red hematite* or *kidney ore* is a botryoidal, mammillated form that mostly occurs in pockets or cavities in particular strata, where it appears to have been introduced subsequently to the deposition of the rocks. This ore has often a radiating fibrous structure, is crystalline and hard, takes a fine polish, and is much used for burnishers. In fine powder it is used for polishing and as a colouring material. Other varieties are *argillaceous hematite*, *reddle* or *red ochre*. These all give a red streak, are anhydrous, and are to be distinguished from the brown hematites, which are hydrous and give a brown streak. See IRON ORE.

HEM'EL HEMP'STEAD, a town of England in the county of Hertford, 23 miles from London on the London and North-western Railway, 1¾ from the Boxmoor station, and about 15 W.S.W. from Hertford. The town stands on the slope of a hill, close to the small river Gade, and consists chiefly of one long street. The females are much engaged in making straw-plait, and there are corn and paper mills in the neighbourhood, some of the latter being among the largest in the kingdom. The market for corn is one of the largest in the county. Some market buildings were erected in 1869. The town also contains a union workhouse and the West Herts Infirmary. The church, a large building, is partly of Norman

architecture, of which the west door is a fine specimen. There are also places of worship for all denominations of dissenters. An excellent supply of water was obtained for the town in 1867 from an artesian well, which was sunk to a depth of 212 feet. The population in 1881 was 4,170.

HEMERO'BIUS. See LACE-WING.

HEMEROCAL'LIS (from two Greek words meaning "beauty of a day"), a genus of plants belonging to the order LILIACEÆ, forming with Phormium (New Zealand flax) and others the tribe Hemerocalleæ. The English name for the genus is Day-lily; the flowers last only a day, but there is always a constant succession. *Hemerocallis flava* (the yellow day-lily) is a native of South Europe. It is sweet-scented, and the perianth-leaves are flat and veinless; it is showy and attractive, and yet hardy. *Hemerocallis fulva* is tawny or copper-coloured, inodorous; the perianth-leaves are veined and wavy. Darwin, in "Animals and Plants under Domestication," quotes a case where "the roots of the large-flowered tawny *Hemerocallis fulva*, being divided and planted in a different soil and place, produced the small-flowered yellow *Hemerocallis flava*, as well as some intermediate forms." There are five species, found in Europe, temperate Asia, and Japan. In this genus the flowers are erect, a few together forming a panicle; the six leaves of the perianth unite at the base into a short tube inclosing the free ovary; the stamens spring from the top of this tube; the anthers have a pit at the back, where the filaments are attached. The capsule has several seeds. The leaves are long and narrow, springing from the rhizome. The species are useful for planting in shrubberies or where large clumps are required.

HEMIHE'DRAL FORMS (Gr. *hemi*, half; and *hedra*, a seat), in CRYSTALLOGRAPHY, are those crystalline forms in which only the alternate faces are developed to the suppression of one-half the faces of the corresponding HOLOHEDRAL FORMS.

These forms are most numerous in those systems only which are possessed of the higher degrees of symmetry; thus in the triclinic system, where the planes are only symmetrical two by two or diametrically opposite, there are no hemihedral forms. Hemihedral forms can only be produced from *closed* holohedral forms; in the tesseral system neither the rhombic dodecahedron nor the cube have hemidral forms. By developing the alternate faces of the other forms we get the tetrahedron, deltoid-dodecahedron, triakis-tetrahedron, pentagonal-dodecahedron, hexakis-tetrahedron; and by developing the alternate groups of faces of the hexakis-octahedron, the diakis-dodecahedron. In the tetragonal system the hemihedral forms are the sphenoid, scalenohedron, and trapizohedron. In the hexagonal system there is a great tendency to hemihedralism. By developing the alternate two faces of the dihexagonal pyramid the scalenohedron is obtained, and by developing the alternate faces of the hexagonal pyramid the rhombohedron is obtained. In the rhombic system a series of sphenoids are the only hemihedral forms possible. In the combinations of forms, hemihedral faces always combine with hemihedral.

HEMIMOR'PHISM IN CRYSTALS. Those crystals dissimilarly terminated—that is, the faces of which, limiting a prismatic zone at one end of the axis, belong to a different crystalline form to those occurring in a similar position at the other end—are hemimorphic. They are also generally pyro-electric. Some remarkable examples of hemimorphism are—in the hexagonal system, tourmaline, ruby silver, and greenockite; in the rhombic system, struvite and electric calamine; and in the monoclinic system, cane sugar. Dissimilarity in the termination of a crystal produced by hemitropism, as in hornblende, should not be mistaken for hemimorphism.

HEMIMOR'PHITE or **SILICATE OF ZINC** is one of the commercial ores of zinc, being the hydrous silicate ($2ZnO.SiO_2+H_2O$) of that metal, of which it contains about 54 per cent. when pure. It occurs in rhombic prisms, the opposite ends being dissimilarly terminated (hemimorphic), hence its specific name. The crystals are pyro-electric. It also occurs in twinned forms, massive, mammillated, and stalactitic. The mineral is brittle, has a hardness of 4·5 to 5, a specific gravity of about 3·5, and perfect cleavage; it is light coloured, and gives the various reactions for zinc. Some of the mammillated varieties are like chalcedony, but of much inferior hardness. From the carbonates of lime and zinc, which it resembles, hemimorphite may be distinguished by its not effervescing with acids.

This mineral occurs associated with CALAMINE, and is a valuable source of zinc, which is extracted from it by first calcining the ore to expel moisture; then, on roasting the residue with carbonaceous substances in closed vessels, the metal becomes reduced, and being volatile distils over; the condensed stuff, when remelted and cast into blocks, is the commercial spelter.

This mineral is also known as Smithsonite, Galmei, and ELECTRIC CALAMINE, and by some as Calamine, the carbonate being then termed Smithsonite.

HEMIO'PIA (Gr. *hemi*, half; and *ops*, the eye) is a disease in which the patient sees only a part of the object he looks at; the middle of it, or its circumference, or its upper or lower part, or more commonly one lateral half, being completely obscured.

HEM'IPINIC ACID, an acid obtained by the oxidation of opianic acid or narcotine, both products from opium. It crystallizes in colourless rhombohedrons, is slightly soluble in water, and very soluble in ether and alcohol. It melts at 180° C. (356° Fahr.), and sublimes at a higher temperature without decomposition. It is inflammable. The formula is $C_{10}H_{10}O_6$, and it is derived from opianic acid ($C_{10}H_{10}O_5$) by the addition of an atom of oxygen. It is a strong dibasic acid, and forms a number of well-defined crystalline salts called hemipinates. It dissolves in strong sulphuric acid without decomposition.

HEMIPLE'GIA, the paralysis of motion of one side of the body. See PARALYSIS.

HEM'IPODE (Hemipodius or Turnix) is a genus of GALLINÆ, the type of the family Turnicidæ. The hemipodes are the smallest game-birds known. They are distinguished from the smaller quails (Coturnix) by the absence of a hind toe and the slenderness of the beak. The Andalusian hemipode (*Turnix tachydromus*) is an inhabitant of Southern Europe and Northern Africa; it has even occurred in England. It is about 6 inches in length, of a brown colour above and yellowish-white beneath, with the breast and throat pale chestnut; the upper surface is variegated with bars and spots of chestnut, black, and yellowish-white. This bird is found in barren spots, and runs with great speed among the scanty herbage. Other species are found in India, China, Australia, &c.

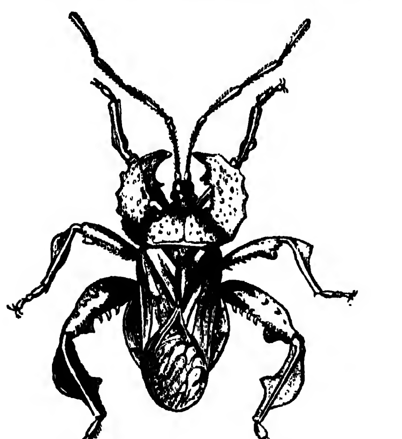
HEMIP'TERA, one of the orders of the class INSECTS. The order Hemiptera, according to Linnæus, contains insects which agree in having incomplete metamorphoses (*i.e.* the larva and pupa both possess the power of locomotion, and bear a great resemblance to the perfect insect), and also in having the superior wings generally coriaceous and the inferior membranous. Thus Linnæus included in this order the cockroaches, locusts, grasshoppers, bugs, Cicadæ, &c. The last-mentioned insects, the bugs and Cicadæ, however, differ very materially from the former, inasmuch as they possess a suctorial instead of a masticatory mouth; and as these latter characters have been considered of great importance by all the more modern entomologists, the term Hemiptera has been restricted to such insects as have imperfect metamorphoses and a suctorial mouth.

The order Hemiptera or Rhynchota, as it is sometimes called, is divided into two suborders, Heteroptera

and Homoptera. The Heteroptera are characterized by having the rostrum or proboscis attached to the fore part of the head; the elytra coriaceous, with the extremity membranous, folding one over the other when at rest; the antennæ elongated, and composed of four or five joints; the tarsi three-jointed; and the prothorax the largest, and forming the most conspicuous part of the thorax. The second section, Homoptera (which by many of the English entomologists is regarded as an order), is distinguished by the proboscis being attached to the lower portion of the head, near the chest; the elytra almost always of a uniform coriaceous texture, with their inner margins straight and contiguous; the three segments of the thorax are united in a mass, and the first is frequently shorter than the second.

The Heteroptera or bugs are divided by Latreille into two sections; the first, or the Geocorisæ, are characterized as having the antennæ free, longer than the head, and inserted between the eyes and near their anterior margin. The second family, to which the name Hydrocorisæ is applied, have the antennæ inclosed and hidden in a groove beneath the eye; the eyes are generally very large.

The species of the section Geocorisæ are for the most part found on the leaves of trees or small plants; some there are which do not quit the ground, and there are others which live upon the surface of the water. Nearly all are vegetable feeders. The family Tingidæ includes many small and exceedingly beautiful insects, as the species of Tingis (Plate, fig. 1), but it also contains an insect whose appearance only excites loathing and disgust, the Bed Bug (*Cimex lectularius*). Fig. 2 of the Plate shows the pretty red and black *Lygæus punctum*, one of the Lygæidæ. The family Coreidæ includes several remarkable forms, some having the hinder thighs much thickened, and others having the margins of the abdomen projecting laterally; to this family belong *Syromastes paradoxus* (fig. 4)



Derepteryx grayii.

and *Derepteryx grayii* (see cut). Berytus (fig. 5), the type of the family Berytidæ, has a very long narrow body and long legs. Tetyra (fig. 3) is one of the Scutelleridæ or shield-bugs. *Hydrometra stagnorum* (fig. 7), an insect with a long slender body and exceedingly long thin legs and antennæ, is found crawling about on aquatic plants in stagnant waters. *Gerris lacustris* (fig. 6) skims over the surface of water with the utmost rapidity.

The insects belonging to the second section (Hydrocorisæ) live, as their name implies, in the water, and they prey upon other insects. This section contains three families, Galgulidæ, exclusively American, Notonectidæ and Nepidæ, European. The Water-Boatman (*Notonecta glauca*, fig. 8), a very common English insect, floats in the water with its under side uppermost, rowing itself very swiftly with its long legs. *Naucoris cimicoides* (fig. 9), one of the water-scorpions (Nepidæ), is also common in England; its fore legs are powerful prehensile organs.

The Homoptera (with the exception of the parasitic forms) all feed exclusively on vegetable juices. They are divided into three sections—Cicadina, Phytophthiria or plant-lice, and Pediculina or lice. Cicadidæ [see CICADA] are remarkable for the musical sounds which the males produce. Fulgoridæ contain the lantern-flies (Fulgora, fig. 13); figs. 10 to 12 also belong to this family. Cercopidæ contains the cuckoo-spits or frog-hoppers. Membracidæ (fig. 14) contains many very bizarre forms. The plant-lice consist of many insects of extreme interest to the entomologist and also to the agriculturist. The COCCIDÆ, or scale-insects, are remarkable for the dissimilarity of the sexes, the male (fig. 15) having only the fore wings developed, while the female has no wings and undergoes degeneration as she reaches maturity. From the bodies of the females of some species beautiful dyes are produced. The APHIDÆ (figs. 16, 17) may be counted among the most formidable foes of the farmer and the gardener. The wings are frequently deficient, especially in the asexual broods. The Psyllidæ are also very destructive to plants; *Psylla buxi* injures box. Aleurodidæ contains only the genus Aleurodes. Pediculina (fig. 18) forms the lowest group of the Hemiptera. These insects [see LOUSE] are very degraded; they are parasitic and wingless.

HEM'ISPHERES. Any plane passing through the centre of a sphere will divide it into two hemispheres. There are three such divisions usually applied to our globe. They are:—1. The *Eastern* and *Western* Hemispheres, the first containing Europe, Asia, Africa, and Australia; and the second the Americas and New Zealand. The division is here by a plane passing through the poles as well as the centre of the earth, in fact it is along the meridian of 20° W. lon., and its opposite half the meridian of 160° E. lon. 2. The *Northern* and *Southern* Hemispheres, divided by the equator, and of which the first contains three times as much land as the second. 3. The *Land* and *Water* Hemispheres, when the dividing plane is at such an angle with the equator that England lies in the centre of the circular map produced. The plane will then cut the eastern hemisphere just below the Cape of Good Hope, through Malay and Cochin-China, and in the western hemisphere it will pass through South America towards the south of Brazil. Speaking as to land surface, only the remnant of South America, Cochin-China, Australia, and the great Asiatic islands and New Zealand are left in the "water" hemisphere, and the "land" hemisphere exceeds it by thirteen times in this respect.

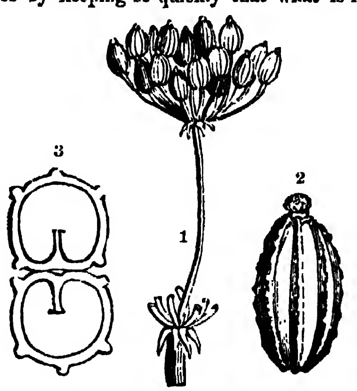
HEMITRO'PES or **MACLES** are twinned crystalline forms in which the two halves bear a reversed position to each other; that is, in a hemitropic crystal there is a plane along which the crystal appears to have been split and turned half round. This plane is the *twin-plane*, and bears a definite relation to the fundamental form. Splendid examples of hemitropism occur in gypsum, the arrow-head forms being produced by hemitropism along the orthodiagonal plane. In hornblende, hemitropism has taken place along the orthodiagonal plane. In orthoclase, hemitropism along the clinopinacoid produces macles of the Carlsbad type,

HEM'LOCK (*Conium maculatum*) is a biennial umbelliferous plant, possessing highly narcotic and dangerous qualities, but used medicinally as a remedy against nervous affections. It grows in wild places, 3 to 6 feet

high, sometimes by the sides of ditches in meadows, but more frequently in light upland pastures, flowering in June and July. It is necessary to pay the greatest attention to the botanical characters of *Conium maculatum*, in order that the genuine one may be collected. It is dis-

Hemlock (*Conium maculatum*).

tinguished by means of the ovate fruit, which has prominent crenated ridges, by the very numerous umbels, the nauseous smell of the hairless leaves when bruised, and the hairless red-spotted stem. The dried ripe fruit is officinal in the Pharmacopœias of Great Britain and India. Christison and Harley have shown that the soft green fruits, just before they come to maturity, are more active than those fully ripe; and accordingly the Pharmacopœia of the United States directs that the full-grown fruit, gathered while yet green, should be used. The fruit deteriorates by keeping so quickly that what is imported



Fruit of Conium Maculatum.

1, A partial umbel loaded with fruit, natural size; 2, the back view of a fruit, much magnified; 3, a transverse section of the same, showing the ridges, the absence of vittæ, and the involute albumen.

from the Continent is worthless. The finely cut fern-like leaves of hemlock contain a very small proportion of the active principle, which is diminished by the process of drying. They should be gathered when the flowers are fully matured, and dried at a moderate heat. Like the fruit, the leaves soon lose all their power. Water hemlock is noticed under CICUTA VIROSA.

The active principle of hemlock is an alkaloid termed *conia*, which, unlike most vegetable alkaloids, is not fixed and crystalline, but volatile and oleaginous. Its activity is increased by union with acids, both mineral and vegetable —a circumstance which shows the impropriety of giving vinegar as an antidote in cases of poisoning by hemlock when any of it is still present in the stomach. Conia appears, from the experiments of Geiger and Christison, to be a deadly poison to all animals. It acts with the most extraordinary rapidity; but, if it fail to kill, its injurious action passes quickly away, and perfect recovery follows. "It exhausts the nervous energy of the spinal chord, producing general muscular paralysis and asphyxia from relaxation." The heart, however, is exempt from this general paralysis, contracting vigorously for a long time after all motion, and respiration, and other signs of life are extinct. It is therefore extremely probable that where a dose is not so large as to produce immediate death, the carrying on of artificial respiration and administering vital stimulants might save the life of the patient, especially as the action of the poison is so transient and incapable of producing a permanently injurious impression. As a medicinal agent hemlock is very valuable, and is frequently used as an anti-irritant and in poultices.

Conium maculatum is a native not only of Britain, but also of temperate Europe and Asia, North Africa, and the Canary Isles. Linnæus considered this plant to be the source of the famous hemlock poison of the Greeks with which Socrates was put to death, and gave the genus the Latinized form of the Greek word *koneion*. The Latin name was *cicuta*, and this had been applied by a mistaken identification of Gesner to another umbelliferous plant, *Cicuta virosa*. Hemlock is mentioned as being used in England as early as the tenth century, and in fact the word is derived from the Old English words *hem*, border, shore, and *leác*, leek.

HEMP is an annual plant, much like the nettle in appearance, allied to it, and still more nearly to the hop, all belonging to the order URTICACEÆ. The hemp plant is known in botany as *Cannabis sativa*. Like the hop, the male and female flowers are produced on separate plants, the female plant being the larger. It grows to a height ranging, according to the mode of planting and situation, from 4 to 10 feet, and a variety in Italy has even attained to 20 feet. The stem is erect, more or less branched; the leaves are compound, made up of three to seven lanceolate leaflets. The flowers are small, greenish, very numerous, springing in bunches from the axils of the upper leaves; the male flower has a five-lobed perianth with five stamens, and the female is composed of a spathe-like perianth with a one-celled ovary and two long stigmas. The fruit is commonly called the "seed."

The hemp plant, both in its male and female form, is mentioned in the most ancient Chinese works, notably in the "Shu-King," compiled by Confucius about 500 B.C., from materials of unknown antiquity. The Sanskrit words are *banga* and *gangika*, of which the root *ang* or *an* appears in all the modern Indo-European and Semitic languages: *bang*, in Hindu and Persian; *ganga*, in Bengali; *hanf*, in German; *hemp* (also *canvas*), in English; *cannab*, in Arabic; *cannabis*, in Greek and Latin; *chanvre*, in French; *kanas*, in Celtic and modern Breton. Herodotus mentions it as being used by the Scythians, but it was little known to the Greeks and Romans, and apparently not used at all by the Hebrews and Egyptians. De Candolle considers that it is native south of the Caspian Sea, and in Siberia, near Irtysch, in the desert of Kirghiz, and even beyond Irkutsk ("L'Origine des Plantes Cultivées," 1883). Hemp is cultivated chiefly for its fibre, and the

seed is sown at a season when the plants are likely to grow very rapidly, in order to form long fibres. When a fine fibre is required, the crop is sown thick and pulled up immediately after flowering; but it is generally left till the seed is ripe, and the fibre has become coarser. The finer kinds of hemp are used for making cloth to which flax is more applicable, and the coarser for sailcloth, canvas, ropes, &c. The dressing of hemp is very similar to that of flax. [See FLAX.] Hemp-fibre is imported into England from Russia, United States, Italy, Holland, Germany, Hungary, Turkey, India, and the Philippines. It is also grown in Ireland, and in Lincolnshire and Suffolk. British hemp is esteemed highly in the market, but the quantity produced is very small. The imports from India and the Philippines include Manilla hemp, sunn-hemp, &c. Hemp is manufactured chiefly into cables, cordage, and canvas.

The seed of hemp is used for feeding birds, and for expressing an oil much used in Russia for burning in lamps, and in this country for making paint. The resin is only produced in hot dry countries, and most of the hemp cultivated in India is grown for the sake of the resin, known there as churras. It exudes naturally, and is gathered either by hand, or it is collected on the leathern dresses or naked skin of men running through the hemp fields, and afterwards scraped off. Bang or hashish consists of the dried leaves. It is smoked or infused in cold water. Ganga is composed of the flowering and fruiting heads of the female plant. It is generally smoked. Hemp consumed in either of these ways is stimulant and intoxicating. A small dose increases the appetite and produces a pleasant excitement; but taken in larger quantities or continuously it brings on hallucination, delirium, and insanity. In Great Britain it is sometimes, though rarely, prescribed instead of opium, for though less certain in its action, it does not produce the same unpleasant effects.

The imports of hemp into the United Kingdom in 1883 were as follows:—

	Cwts.	Value.
Russia, . . .	361,319	£480,223
Germany, . .	224,728	284,255
Italy, ...	224,975	385,456
Philippine Islands,	330,130	747,031
Other Countries,	299,400	466,597
Total	. 1,440,552	... £2,363,562

HEMP'STEAD BEDS form the upper members of the OLIGOCENE series in Hampshire. They occur in the Isle of Wight, overlying the BEMBRIDGE BEDS, and consist of a series of marls and clays that attain a maximum thickness of about 170 feet. The most characteristic fossils are *Voluta rathieri*, *Cerithium elegans*, *Hydrobia chastellii*, *Cyrenia semistriata*, *Corbula pisum*. In the lower beds bones of *Hyopotamus bovinus* occur.

The subdivisions of the Hempstead beds are:—

Corbula Beds.—Brown and greenish clay with shelly bands of marine origin, and containing *Corbula pisum* and *Corbula vectensis*.

Upper fresh-water and estuarine marls, containing *Cerithium plicatum*, *Cerithium elegans*, Corbula, Rissoa, Hydrobia, Melania, Paludina.

Middle fresh-water and estuary marls, containing *Cyrena semistriatus*, *Cerithium rissoa*, *Panopæa minor*.

Lower fresh-water and estuary marls, containing *Melania muricata*, &c., with Chara, Gyrogonites, and other aquatic and terrestrial plants.

HEN'BANE (Hyoscyamus), a genus of plants belonging to the order SOLANACEÆ. One of the species of this genus, *Hyoscyamus niger* (common henbane), is an indigenous herbaceous annual or biennial plant. The leaves and seeds of the biennial form are officinal. It is cultivated at Mitcham and other places in England. It is native also in Central and Southern Europe, and in Western Asia. The leaves should be collected when the plant is flowering, dried quickly, and preserved in well-closed vessels in a cool dry place. The virtue of the leaves is dependent on the presence of hyoscyamia, which, however, is more easily obtained from the seeds. The seeds when bruised evolve an odour of henbane. The taste is oily and bitter; by expression they yield a fat oil, and also furnish a very powerful extract, as well as hyoscyamia. This alkaloid crystallizes in stellated acicular crystals, with a silky lustre; but it more generally occurs in a colourless, transparent, soft, viscid mass. When properly dried it is devoid of odour; but when moist, and particularly when in an impure and coloured condition, the odour is highly disagreeable, stupefying, and tobacco-like. Its properties are almost the same as those of atropine, but it differs in being soluble in water. Its action, even in a small quantity, is extremely narcotic and fatal, like nicotine. It kills more slowly than conia [see HEMLOCK], and scarcely causes convulsions. Applied externally to the eye, even in a very minute quantity, it causes great and enduring dilatation of the pupil.

Hyoscyamus, when taken by a person in health, produces disorder of the nervous system, inducing symptoms greatly resembling hysteria, if the dose be moderate; but if large it causes all the phenomena of narcotic poisoning. Administered in medicinal doses to persons with disturbance of the nervous system, it lessens the irritability, quiets the circulation, and, when morbid wakefulness exists, disposes to sleep. It possesses a superiority over opium in many instances, as it does not constipate the bowels, but rather acts as a mild laxative.

In cases of accidental poisoning the stomach-pump should be used, or an emetic of sulphate of zinc be given. If the brain should appear much oppressed, venesection may also be resorted to.

In this genus the corolla is funnel-shaped; the fruit is inclosed within the persistent calyx, and consists of a capsule opening by a transverse lid. The botanical name is the Latinized form of the Greek word for the plant, which signifies hog-bean.

HEN'GEST and **HOR'SA** (that is to say, *stallion* and *mare*) were the names of the chiefs of the Jutes who were the first English invaders who really got a foothold in Britain. They had doubtless been among the other raiders and plunderers who had harassed the Britons for many years. Nevertheless the bitter need of the Britons, torn by internal feuds and at the mercy of not only these English pirates, but of Pictish and Scottish marauders, suggested to them to call in the help of one enemy in order to hold at bay the other two. Consequently Vortigern, king of Kent, by holding out rich hopes of pay prevailed upon the chiefs Hengest and Horsa (names doubtless of an ancient prehistoric heraldry, imitated later in our William the Lion, and the like) to collect all their forces available and sail across to Britain in A.D. 449. Freeman points out that Kent is the only county or part of the east of Britain which has retained its British name. The Cantii were known to Cæsar, and their land is Kent to our day, though the Cantii themselves, if any are left of their descendants, are in Cornwall or Wales. Later accounts make Vortigern marry Hengest's daughter Rowena; but since Rowena is not an English name the story is almost certainly an invention.

Hengest and Horsa landed at Ebbsfleet in the Isle of Thanet, the present marshes of Minster being then a broad inlet of the sea, cutting off Thanet from the mainland, and guarded at each end by the fortresses of Richborough and Reculver. Here they received permanent quarters, and doubtless kept their ships at hand ready for retreat to their home if need were. One great battle sufficed to scatter the Picts to the winds; but meanwhile the Jutes were too comfortable in Thanet to care about retiring when their

work was done. Others, too, from the older continental "England" kept arriving, and at last the chiefs determined to make a bold dash for the possession of the country whose richness and fertility were so alluring. They crossed to the mainland at low water and seized the London road before the British were aware of their design. Their first great obstacle was the fortress of Rochester, guarding the Medway. Avoiding this they turned southward as far as Aylesford, where they forded the Medway in a terrible fight which cost them the life of Horsa. This was in 455. A cairn was raised over his grave, and its site is called Horsted to this day. Hengest pursued his conquest unrelentingly. The Britons were not only conquered, they were driven back or slaughtered. Hardly a trace of their existence has been left, so terrible and thorough was their destruction. The Britons, appalled at this savagery, resisted only once more at the passage of the river Cray, and then fled to London. Hengest stayed further pursuit and devoted himself to completing his work in Kent, and in six years he held the whole of the county. Another ten years or so (477) saw the Saxon tribe of English following the example of their Jutish brethren, and conquering the shires to the south and west of the dominion of Hengest. This dominion at first was divided into East Kent and West Kent, but the first was always the more important, and held the chief city, called in Old English *Cantwardbyrig* (Kentmen's-burgh), which we now shorten to Canterbury. The "White Horse of Kent" has descended from the device of these first English princes to our own times, and still remains the arms of the county.

The other Jutish conquests in England, the Isle of Wight and the adjoining coast of Hampshire, were not due to Hengest and Horsa, but evidently succeeded the Sussex conquests, the invaders creeping along the shore of the Channel bit by bit. For the same reason they must have preceded the Wessex conquest of 495, when Cerdic and his followers sailed up Southampton Water to make their dash upon Winchester.

HEN'NA is the name of a shrub the leaves of which are used by ladies in the East to stain their finger-nails an orange-red colour. This curious custom is of great antiquity, for there are representations of it in the ancient Egyptian paintings, and even the nails of mummies have preserved the stain. The Persian name is *hanna*, and De Candolle considers that the shrub spread from Persia or the boundaries of Persia and India throughout the East, as the custom was introduced into the various countries. Although it is found at the present day apparently wild throughout India, Arabia, and North Africa, it is doubtful whether this is not due to very ancient culture. The Hindu name is *hina*; the Arabs call it *henneh* and *al-henneh*, and the modern Greeks *kinna*.

Shaw, in his "Travels in Barbary," says:—"At Gabs there are several large plantations of palm-trees, though the dates are much inferior, both in size and taste, to those of the Jireed. But the chief branch of trade, for which this emporium, as Strabo calls it, is famous at present, arises from the al-henneh, which is plentifully cultivated in all their gardens. This beautiful odoriferous plant, if it is not annually cut and kept low, as it is usually in other places, grows 10 or 12 feet high, putting out its little flowers in clusters, which yield a most grateful smell like camphor, and may therefore be alluded to in Cant. i. 14, where it is said—'My beloved is to me as a cluster of cypress (or al-henneh) in the vineyards (or gardens) of Engedi.' The leaves of this plant, after they are dried and powdered, are disposed of to good advantage in all the markets of this kingdom; for with this all the African ladies that can purchase it tinge their lips, hair, hands, and feet, rendering them thereby of a tawny saffron colour, which with them is reckoned very beautiful. The al-henneh, no less than the palm, requires to be frequently watered; for which purpose the river that runs through these plantations is cantoned out, as it seems to have been in the time of Pliny, into a number of plantations."

Branches or clusters of the fragrant flowers of this plant are still much used by Eastern ladies as ornaments for the breast and the hair. The expression, "pare her nails," given by our translators in Deuteronomy xxi. 12, is rather "adorn her nails," and most likely refers to the Eastern use of the henna.

The preparation of henna is made by powdering the leaves, and sometimes mixing with catechu or Lucerne leaves, also powdered. This is mixed with hot water to form a paste, and is then applied. It requires renewing

Henna (*Lawsonia inermis.*)

after three or four weeks. It is also used for dyeing the hair and beard, the manes and hoofs of horses, skins, and morocco leather. A deep black colour is produced by using indigo after henna. In the West Indies it is called Jamaica mignonette. It is known in English gardens as Egyptian privet.

Henna is a shrub, 8 or 10 feet high, with opposite broadly lanceolate leaves, and small, white, sweet-scented flowers, growing in panicles. The calyx is deeply cut into four divisions; there are four petals, with corrugate margin; eight stamens in pairs alternate with the petals; a globose

four-celled capsule, which bursts irregularly. There is only one species in the genus, *Lawsonia alba;* but two forms, one with spines and the other spineless. Lawsonia belongs to the order LYTHRARIEÆ.

HENRY I., KING OF ENGLAND, surnamed *Beauclerc*, the fourth and youngest son of William the Conqueror, was born in 1068 at Selby in Yorkshire. The eldest son, Robert, was not favoured by his father, and although by French feudal law he succeeded him in the dukedom of Normandy, the Conqueror at his death expressed the wish that his third son, William, should be his successor in England, his second son, Richard, having died while hunting in the New Forest. The Conqueror only left Henry a legacy of £5000 of silver. With £3000 of this, however, Henry obtained, through the indifference of his brother Robert, the whole of the district of Cotentin, comprehending nearly a third of Normandy. When Robert and William, after having been at war in Normandy, made peace, they turned their united arms against Henry, who was compelled to evacuate even his last stronghold, the fortress built on the lofty rock of St. Michael, after which he wandered about for some two years in a state nearly akin to destitution. At length, on the invitation of the inhabitants of the town of Domprout, he assumed the government of that place; and it would appear that from this point of support he gradually raised himself to the repossession of nearly all the territory that he had lost. He also became reconciled to William, and was in England and in the New Forest with that king when he came by his death (2nd August, 1100). He was crowned on 3rd August in Westminster Abbey. The next day he published a charter confirming the rights and liberties both of the church and of the nation, and promising the restoration of the laws of the Confessor, with only such alterations as had been made in them by his father. Henry from the first put forward his English birth as one of his chief claims to acceptance with his subjects; and he hastened to strengthen this title by his marriage with Maud, or Matilda, daughter of Malcolm king of Scotland and Margaret, the sister of Edgar the Atheling. Henry's children thus inherited the old royal blood of Wessex by their mother.

The history of the reign opens with the contest between Henry and his elder brother Robert for the crown, which resulted in an agreement that Henry should retain England and Robert Normandy, and that Robert should receive a pension of 3000 merks yearly.

Henry, however, found a legitimate excuse for breaking the agreement, in the pressing invitations which came to him from Normandy to come and free the land from his brother's oppressive rule. Henry at length crossed to Normandy with an English army, and levied war upon his brother, the result of which was the utter ruin of Robert and his cause. Robert himself was taken prisoner, with 400 of his knights, at the battle of Tinchebray, and condemned by Henry to confinement for life. (According to Matthew Paris, an unsuccessful attempt which he soon after made to effect his escape was diabolically punished by the extinction of his sight; and in this state the prince survived for twenty-eight years, dying in Cardiff Castle, at the age of eighty, in February, 1135, not quite twelve months before the death of Henry.) Henry was, without opposition, acknowledged their duke by the Norman barons.

The next six or seven years passed without any events of much moment. In 1118, however, Henry was attacked in Normandy by Louis VI. of France and Fulc, count of Anjou, in support of the interests of William, styled Fitz-Robert, the son of Duke Robert. The war lasted about two years, and was on the whole adverse to Henry. It was followed by other contests, which were not finally settled until 1120.

Immediately after the peace Henry's brightest hopes were dissipated by the great calamity of the loss, on the 25th November, of the ship in which his son, who had been affianced to Matilda, daughter of the Count of Anjou, had embarked at Harfleur for England; with the exception of one individual, a butcher of Rouen, all on board perished, to the number of nearly 300 persons. Henry is said never to have been known to smile after this event. Two years before this he had lost his consort; and a daughter, Matilda, married in 1114 to the German Emperor Henry V., was now his only legitimate progeny. In the hope of male offspring, he (2nd February, 1121) espoused the young and beautiful Adelais, or Alice, daughter of Geoffrey, duke of Louvain.

When four or five years of his second marriage had passed without producing any issue, Henry determined upon securing the succession to his dominions for his daughter, who had become a widow in 1125. On Christmas Day, 1126, she was unanimously declared his heir, in a great council of the lords spiritual and temporal assembled at Windsor Castle. The following year she was married to Geoffrey, surnamed Plantagenet, the son of Fulc, count of Anjou, to whom, although only a boy of sixteen, his father had resigned that county on his departure for the Holy Land, where he was a few years afterwards elected King of Jerusalem. It was not, however, till March, 1133, that Henry's longings were gratified by the birth of Matilda's first child, Henry, surnamed Fitz-Empress (afterwards Henry II.) Henry I. died at Rouen on 1st December, 1135. He had completed the sixty-seventh year of his age and the thirty-fifth of his reign. Henry's surname, Beauclerc or Fine Scholar, was given him in honour of his learning, which for a king of that period was considerable. He translated Æsop's Fables, and he gave great encouragement to learning in others. In the administration of justice he was stern and impartial, but crime he punished with excessive severity. In the conduct of public affairs he displayed great administrative ability, though in his political intrigues he proved himself to be unscrupulous and faithless, and in his private life he was guilty of gross immorality.

During his reign the coinage was increased and purified, a standard of weights and measures was established, rents began to be paid in money instead of in kind, and the manufacture of woollen cloth was introduced by some Flemings who settled in Pembroke and Norfolk.

HENRY II., KING OF ENGLAND, surnamed *Fitz-Empress*, was the eldest son of the Count of Anjou, Geoffrey Plantagenet (so named from a sprig of broom—in Latin *planta genista*, in French *plante genêt*—which he used to wear in his cap as a cognizance), and Matilda, daughter of Henry I. of England and widow of the German emperor Henry V. He was born at Le Mans in March, 1133. In the struggle between Stephen and Matilda for the English crown, Matilda's husband, Geoffrey, had, by the year 1141, reduced nearly the whole of Normandy, and his son Henry was, in 1150, formally invested with that dukedom by Louis VII. of France, the portion of the country called the Vexin being ceded to Louis as the price of his consent to the arrangement. By the death of his father, 10th September, 1151, Henry became Count of Anjou, Touraine, and Maine. On Whitsunday of the year following, within six weeks after she had been divorced from her first husband, King Louis VII. of France, he married Eleanor, in her own right Countess of Poitou and Duchess of Guienne or Aquitaine, an alliance which made him master of a third part of France, including all the western coast, with the exception only of Brittany, from the Somme to the Pyrenees, and far exceeding the possessions of King Louis himself. Soon after this Henry sailed for England at the head of a small but well-appointed force. He and Stephen came in sight of each other at Wallingford, and in an interview which they had there, standing on opposite sides of the Thames, they agreed to a truce. The death of Eustace, Stephen's eldest son, having first removed the chief obstacle

to a permanent arrangement between the two competitors, the death of Stephen, 25th October, 1154, made Henry king of England without opposition.

His first proceedings were strikingly indicative of the system of combined energy and policy which continued to characterize his government. He dismissed the foreign troops which Stephen had brought into the kingdom, razed to the ground nearly all the numerous castles that had been erected throughout the country by the barons in the preceding twenty years of anarchy, and resumed with remorseless determination all the lands that had been alienated from the crown since the death of Henry I., those grants only excepted that had been made to the church and to William, the second son of Stephen.

His presence was soon called for across the sea by the attempt of his younger brother Geoffrey to wrest from him his paternal inheritance of Anjou, Touraine, and Maine. After a very short contest Geoffrey was forced to give up his claim in exchange for a pension, but he died about a year afterwards, 1158. Henry had already recovered from the young Malcolm IV. of Scotland the northern counties which had been taken possession of by his predecessor David I., and had driven back the Welsh from those parts of the English territory which they had seized during the reign of Stephen. His next attempt was upon the county of Toulouse, which he claimed in right of his wife Eleanor, whose grandfather William, duke of Aquitaine, had married Philippa, the only child of William, fourth count of Toulouse. He was here opposed both by Raymond de St. Gilles, the descendant of a brother of the same Count William, and by Louis, king of France. The contest which ensued was suspended by a peace in May, 1160, by which Henry was allowed to retain a few places he had conquered in Toulouse; and although the war soon broke out anew, it was after a few months put an end to by a second peace, concluded in 1162 by the mediation of Pope Alexander III.

The history of the reign of Henry II. for the next eight years is principally that of the contest as to the freedom of the clergy from royal supremacy between the king and the Archbishop of Canterbury, and is fully recounted in the article BECKET, THOMAS A'. But during this period two formidable insurrections of the Welsh which broke out in 1163 and 1165 were repressed, and in 1166 a revolt of the people of Brittany against their duke, Conan, afforded Henry a pretext for assuming to himself the direct administration of affairs in the name of his son Geoffrey and Conan's daughter Constance, between whom, young as they both still were, the marriage ceremony was now solemnized for the sake of this arrangement. This gave Henry the whole western coast of France. Some further hostilities in which he now became involved with the French king were terminated by the peace of Montmirail, 6th January, 1169. By this treaty it was arranged that Henry, the king of England's eldest son, should do homage to Louis for the counties of Anjou and Maine, and that his second son Richard should in like manner hold the duchy of Aquitaine of the French king, and espouse Adelais or Alice, the youngest daughter of Louis. Amidst these many cares came the sham reconciliation with A'Becket, followed by his arbitrary conduct in England on his return, the king's hasty wish that he were rid of such a man, and the murder of the archbishop by Henry's too eager servants (1170). A'Becket was sainted in 1172, and Henry's famous penance took place in 1174. The greatest event which divided the manifold activity of Henry with the affairs of A'Becket was the conquest of Ireland, which was begun in 1169 by a body of private adventurers, headed by Richard de Clare, earl of Pembroke, the celebrated Strongbow, and completed by Henry in person, who crossed over from Milford to Waterford with a powerful armament, 18th October, 1171, and a protracted struggle ensued between the people and their invaders; but the acquisition of Ireland was finally sealed by a formal treaty concluded in 1175 with Roderick O'Connor of Connaught, considered the head king of the country, in which he consented to become Henry's liegeman and to pay an annual tribute. The insolence of the new governor, Prince John, soon destroyed what order his father had brought among the Irish chiefs, and he had to be recalled. The "English pale," as it was called, then diminished to the districts of Drogheda, Dublin, Wexford, Waterford, and Cork, for Henry had to attend to the disorders succeeding the murder of A'Becket, and never had further leisure for Irish conquests.

Much of the remaining portion of Henry II.'s life and reign presents an involved and deplorable scene of family discord and contention. His eldest son Henry had been, as heir-apparent, crowned in Westminster Abbey on Sunday, 15th of June, 1170. On this account, at the instigation, it is said, of his father-in-law, King Louis, the prince advanced the pretension that he had become entitled actually to share the royal power with his father, and he demanded that Henry should resign to him either England or Normandy. His refusal was speedily followed (in March, 1173) by the flight first of the prince, and then of his younger brothers Richard and Geoffrey, to the French court. About the same time Queen Eleanor also left her husband to associate herself openly with the rebellion of her sons, of which she had in fact been the prime mover. She was also making her way for the French court when she was caught dressed in man's clothes and brought back to Henry, during the rest of whose life she remained in confinement. How far her French proclivities may have led her on, and how far the natural resentment of a wife at openly avowed infidelity on the part of her husband, we know not. Henry, it is said, for one of his mistresses, Fair Rosamond, built at Woodstock a bower protected by such tortuous entrance-passages that it was difficult to enter it unguided. Queen Eleanor, as the tale runs, had the entrance betrayed to her, and suddenly appeared before her guilty rival and offered her immediate choice of the dagger or the bowl as the instrument of death. Fair Rosamond chose the poison, drank it, and at once expired. Unhappily both bower and poison are inventions of later times, though it seems a pity to spoil a fine old legend. Rosamond was the daughter of Walter Clifford, and her sons by Henry became Earl of Salisbury (William Longsword) and Archbishop of York.

The cause of young Henry was supported not only by France and Flanders, but also by Scotland, and by some of the most powerful both of the Norman and the English barons. The war continued for about two years, during which the most important event that happened was the capture of King William of Scotland at Alnwick Castle by the justiciary De Glanville, 12th July, 1174. Soon after this Henry, who had throughout decidedly the best of the contest, assented to the petition of his sons for a peace. In December, 1174, the Scots acknowledged their feudal dependence in return for the liberation of King William. In 1183 another outbreak of the fierce and turbulent spirit of the princes led the way to a new succession of family wars. After deserting his father and his youngest brother alternately about half a dozen times, Prince Henry was suddenly taken ill and died, expressing his repentance at his conduct, at Château-Martel, 11th June, 1183, in the twenty-seventh year of his age; and Geoffrey was, in August, 1186, thrown from his horse at a tournament, and so severely injured that he died in a few days after.

Jerusalem was taken by Saladin in 1187. A project of a new Crusade at the call of Pope Clement III., in the beginning of 1188, for a moment united Henry II. and Philip the new king of France, and the Emperor Barbarossa also joined them. The impetuous Prince Richard of England actually took the cross; but before the end of

the same year the unhappy father saw his son again bearing arms against him in alliance with the French king. Henry's spirit seems to have given way at last as he was driven by their superior combined strength from his birthplace, Le Mans. He cursed God and sued for peace. It was granted on terms very humiliating to the king. Henry was stretched on a sick-bed when the treaty was read to him, but when he found in the list of those that had deserted him to join Richard his youngest and favourite son John, the discovery appears to have broken his heart; he turned himself to the wall, saying, "Let things go as they will, I care no more for them or the world." He was soon after removed to Chinon, on the Loire; and there, after a few days more of suffering, he died, 6th July, 1189, in the fifty-eighth year of his age and the thirty-fifth of his reign. He was buried in the choir of the abbey of Fontevrault.

It is not too much to say that Henry II. was the foremost sovereign of his time. He represented not so much an individual as a race. In the article on the FULCS OF ANJOU the fierce, superstitious, irreverent, cruel, vigorous, capable stock, whose characteristics he summed up in himself even to their disregard of parental affection and filial respect, are shadowed forth. Green says justly ("Short History"), "He was the hardest worker of his time. There was something in his build and look, in the square stout frame, the fiery face, the close cropped hair, the prominent eyes, the bull neck, the rough strong hand, the bowed legs, that marked out the keen, stirring, coarse-fibred man of business." One of his courtiers tells us he never sat down, he was on his legs from morning till night. Living sparely, in incessant activity, his almost sole relaxation the toilsome pleasures of the chase, he reflects the restless character of the time. Yet he was curiously set against it. He, a foreigner, a great continental prince, was called to rule a people which from many mixed sources was developing into a nation. Henry never even saw this. In the great religious and national revival under A'Becket he only detected the attack on his supremacy. A more reverent prince would have led the movement and turned it to his own purposes, instead of fighting it in its good as well as its evil, and perishing through the hard won victory.

But though Henry was not of his time, so far as its great subtle movements were concerned, he was emphatically the right king in externals. In a disorderly time he was the enthusiast for order. We owe our law-abiding character as a people to the impulse set by his wise legislation. The activity of Henry, and indeed of all our Angevin kings, is astounding to us moderns. Finding himself hampered in the ceaseless petty wars with his sons by the conflicting claims of the Norman feudal system, he carried out an entire change of tenure, received a *scutage* or money tax instead of personal service, and with this hired mercenaries who owned no master but himself. He reorganized the county government by sheriffs. He refounded the ancient English militia, wherein every man had to be ready with arms according to his degree of rank, from the knightly panoply to the pike of the poor man, and all were bound at the royal summons to attend in defence of the realm (Assize of Arms, 1181). The *Assizes* of Henry, of which this was one, were codes of laws promulgated by the king with the advice of his barons, and together form a splendid body of early legislation. The Assize of Clarendon (1166) in reviving the frank-pledge, or mutual responsibility for preserving the king's peace among fellow-townsmen, &c., incidentally founded trial by jury, so far as the *grand jury* is concerned. Twelve men of each hundred and four of each township were to be sworn to present for trial those known or suspected as criminals in their district. They combined the character of witnesses and of judges. (Extra witnesses were added to these jurors under Edward I., and a little later, by the division of the witnesses from the jury, the latter adopted their judicial position.) The Assize of Northampton (1176) went further, and divided the land into six circuits, each with three itinerant justices, which division has substantially lasted till our own day. His object was not only judicial, but financial as well; the judges heard the king's pleas, but also collected the king's moneys. Appeals arose to the king from his judges, and Henry's Court of Appeal, thus made necessary, has also come down to us with successive changes of title, now existing in the judicial functions of the House of Lords. But it also quickly developed into the King's Council, and after many ages into the Privy Council; while the King's Court, which was composed of the judges collectively, branched out in the next reign into the three divisions of the King's Bench, the Common Pleas, and the Exchequer, which under Queen Victoria have all united once again to become the Queen's High Court of Justice. All Henry's legislation was for the whole of his people alike. There was no distinction between Normans and English, between baron and villein. One would fain believe that so great a king of England spoke English. He certainly understood it, but it is not quite clear that he used it himself; although it is known that the great nobles commonly knew both the French and English languages at this time.

Lord Lyttelton's "Life of Henry II." (London, 1773) gives a good account of the reign in general. Robertson's "Materials for a History of A'Becket" (London, 1876) is partisan in tone, but a work of great research. It forms part of the great series published under the sanction of the master of the rolls. The vast mass of material recently edited in the Rolls Series of chronicles, &c., lie ready to the hand of some future historian, who will give us a better picture than hitherto of this great king. Among them one of the best, the invaluable contemporary record of William of Newburgh (edited by Howlett) appeared in 1884.

HENRY III., KING OF ENGLAND, surnamed *of Winchester*, was the eldest son of King John by his queen, Isabella of Angoulême, and was born 1st October, 1206. His father having died 18th October, 1216, the boy was, chiefly through the influence of the Earl of Pembroke, acknowledged heir to the throne, and on the 28th was crowned in the abbey-church of St. Peter at Gloucester by the papal legate, Gualo. His reign is reckoned from that day.

On the 11th November following Pembroke was appointed protector or governor of the king and kingdom, and after his death the administration fell into the hands of Hubert de Burgh. In 1222 Henry had been declared of age to exercise at least certain of the functions of government; but his feeble character had already become sufficiently apparent, and this formality gave him no real power. De Burgh conducted the government with ability and success, though in a spirit of severity which could not fail to make him many enemies. A growing opposition to De Burgh was at length headed by Richard, earl of Cornwall, the king's brother, and the consequence was the sudden expulsion of that minister from all his offices, and his consignment to prison, with the loss of all his honours and estates, in the latter part of the year 1232. Des Roches, the bishop of Winchester, who had retired from the country, returned, and was now placed at the head of affairs; but a confederacy of the laity and the clergy, with Edmund, archbishop of Canterbury, at its head, compelled his dismissal. The archbishop now became chief minister. In 1236 Henry, being now in his thirtieth year, married Eleanor, the daughter of Raymond, count of Provence. In the midst of contests between the crown and the nobility, whose meetings for deliberation on national affairs were now commonly called Parliaments, a renewal of active hostilities with France was brought about through a private resentment of Henry's mother, Isabella, who, after the death of John, had returned, and had been remarried to Hugh, count of La Marche. Henry sailed for the

Continent; but, after being beaten by Louis in a succession of actions, he was glad to get home again, with the loss of army, money, baggage, and everything. A new truce for five years was then agreed to between the two countries.

The contest with the crown ended for the present in an attempt on the part of Henry to govern by the prerogative. The exorbitant extent to which Henry carried his exactions raised a spirit of resistance, which broke out into open revolt. What is called by most of the old chroniclers "the mad Parliament" assembled at Oxford, 11th June, 1258, and placed the whole authority of the state in the hands of a committee of government, consisting of twelve persons appointed by the barons and as many by the king. The leader of the barons on this occasion was the famous Simon de Montfort, who was a Frenchman by birth, but who in right of his mother had succeeded to the English earldom of Leicester, and had married Eleanor, countess-dowager of Pembroke, a sister of King Henry. He and his friends soon contrived to monopolize the whole power of the committee. The quarrels of the adverse factions enabled Henry, in the beginning of 1261, to throw off their authority, and although the parliamentary party was on this occasion joined by Prince Edward, it was for the present effectually put down, De Montfort himself being obliged to take refuge in France. After a temporary restoration of De Montfort to power, we soon find the contending parties in open warfare, and on 14th May, 1264, the forces of the barons, led by De Montfort, and those of the royalists, commanded by the king in person and by his son Edward, met at Lewes in Sussex, where the former gained a complete victory, both Henry and his son being taken prisoners. Prince Edward contrived to make his escape from Dover Castle, and to join the Earl of Gloucester, who had now deserted the interest of De Montfort, at Ludlow, in Shropshire. On the 4th of August the two parties again encountered at Evesham; and the result was the defeat of the baronial forces with immense slaughter, De Montfort himself and his son Henry being both among the number of the slain. A final arrangement with the De Montfort party was at last effected in a Parliament which met at Marlborough on the 18th of November, 1267. Henry's son Edward set out for the Holy Land in July, 1270, from which he had not returned when Henry died at Westminster, 16th November, 1272, in the sixty-seventh year of his age and the fifty-seventh of his reign.

The reign of Henry III. is memorable as affording us the first distinct example of a Parliament constituted, as at present, of representatives. Our statute law also begins with this reign.

Henry IV., King of England, surnamed *Bolingbroke*, was the eldest son of John of Gaunt, duke of Lancaster, the fourth son of Edward III. His mother was the Lady Blanche, younger daughter and eventually heiress of Henry Plantagenet, duke of Lancaster, who was grandson of Edmund, second son of King Henry III. He was born at Bolingbroke in Lincolnshire in 1366. In 1397 he was created Duke of Hereford, having married Mary, daughter and coheir of Humphrey de Bohun, the last earl of Hereford.

The first occasion on which he appears in English history is as one of the lords associated with Thomas, duke of Gloucester, the uncle of Richard II., in the insurrection of 1387; and ten years after we find him accusing the Duke of Norfolk, who was also concerned in the rebellion, of having spoken disrespectfully of the king, by expressing his opinion that, although Richard had received them into his favour, he still cherished a determination of revenge. It was arranged that the charge should be brought before a high court of chivalry. That court assembled at Windsor on the 29th of April, 1398, and awarded that wager of battle should be joined between the two dukes at Coventry on the 16th of September. When the day arrived, and the combatants were on the point of advancing to the encounter, the king, who presided, suddenly threw down his warder, and so arrested them both where they stood. Norfolk was ordered to go on a pilgrimage to the Holy Land, and was banished from England for life; Hereford was also sentenced to quit the kingdom within four months, and to remain abroad for the next ten years. He retired to Paris, and while he was resident in that city his father, the Duke of Lancaster, died 3rd February, 1399, on which Richard immediately seized his estates, on the pretence that the banishment of the son disqualified him from inheriting. Henry landed with a few attendants at Ravenspur in Yorkshire on the 4th of July, while Richard was in Ireland. He was immediately joined by the Earls of Northumberland and Westmorland, and when Richard returned from Ireland he found his kingdom had passed from him. Richard was deposed by Parliament 30th September, 1399, and Henry was proclaimed king. Richard was sent into confinement at Pontefract, and after a few months' imprisonment was secretly murdered. Military operations were then commenced on the side both of Wales and Scotland, in the former of which countries an insurrection, headed by the famous Owen Glendower, baffled all Henry's efforts during several successive campaigns to put down; while two Scottish armies that marched across the borders pretending that they came to restore King Richard, who was said to be still alive and resident at the northern court, were defeated, the first on the 22nd of June, 1402, at Nesbet Moor, the second on the 14th of September in the same year, in the much more destructive fight of Homildon Hill. The victorious commander in this last affair was Harry Percy, the renowned Hotspur, eldest son of the Earl of Northumberland. That great house, conscious of its power and its services, now broke with the king of its own making on his refusal to permit the ransoming of Harry Percy's wife's brother, Sir Edmund Mortimer, who had been taken prisoner by Glendower. A most formidable rebellion followed, but was suppressed on the 21st of July, 1403, by the battle of Shrewsbury, in which Harry Percy was himself slain. Before the end of 1405 Owen Glendower was effectually subdued, and a truce with Scotland had restored quiet in that quarter. It was at the time of this truce that on the 30th of March, 1405, an English cruiser captured the ship in which James, the eldest son of King Robert of Scotland, was proceeding to France. Henry retained possession of the young prince, who, becoming rightfully King James I. of Scots the following year by the death of his father, remained a prisoner in England till 1424. But though Henry IV. thus kept James prisoner he took care to give him the best education the times afforded, to the great benefit of Scotland when at length he was permitted to assume his crown. About the same time Henry detected a conspiracy against his life, one of the principal persons engaged in which was his cousin Edward, duke of York, whose estates were immediately forfeited to the crown; and he quelled another insurrectionary attempt of the Percys, headed by Scroop, archbishop of York, who was punished by death on the scaffold. A third northern insurrection, the last effort of the old Earl of Northumberland, who had some years before been deprived of his estates and outlawed, was put down, 28th of February, 1408, at the battle of Bramham Moor, near Tadcaster, in which the earl himself fell. Meanwhile an irregular war with France had been carried on merely because one of the charges brought against Richard II. had been his apathy with regard to the French claims of Edward III. But Henry IV. was not in earnest, and these transactions led to no important national results during this reign.

During the latter years of his reign Henry was afflicted with a disfiguring skin disease, and by attacks of epilepsy, from one of which he died, 20th March, 1413, in the forty-seventh year of his age and the fourteenth of his

reign. Owing to his defective title to the crown and the difficulties of his position, he was compelled to defer in a great degree to the House of Commons, and the power of that assembly increased considerably during this period. Before his accession he was suspected, like his father, of a leaning to the doctrines of Wyclif; but during his reign, in order to gain the support of the clergy, he passed very severe laws against the Lollards. The first victim of these laws, and the first man to suffer death for his religious opinions in England, was a priest named William Sawtree, who was burned at Smithfield in 1401.

HENRY V., KING OF ENGLAND, surnamed *of Monmouth*, from the place of his birth, was the eldest son of King Henry IV. by his first wife, and was born in 1388. He was educated at Queen's College, Oxford, under the superintendence of his uncle, Cardinal Henry Beaufort. The Beauforts were sons of John of Gaunt, duke of Lancaster, by his mistress Catharine Swynford, and therefore half-brothers of Henry IV. When his father was in exile in 1399, he and a son of the Duke of Gloucester were carried to Ireland and placed in custody in the Castle of Trim, where they remained till the deposition of Richard. On his father's accession he was created Prince of Wales, Duke of Guienne, Lancaster, and Cornwall, and Earl of Chester. It is said that the renown and popularity the prince acquired by his military successes in Wales so inflamed the jealousy of his father as to occasion his recall from the army, and that after this he drew upon himself as much reprobation by his wild and dissipated life as he had gained favour by his previous conduct.

Henry V. was proclaimed king on 21st April, 1413, the day after his father's death. He began his reign with several acts of a generous stamp—transferring the remains of Richard II. to Westminster Abbey; releasing the young Earl of March from the captivity in which he had been held all the preceding reign; and recalling the son of Hotspur from his exile in Scotland to be reinstated in his hereditary lands and honours. He had been seated on the throne little more than a year when he entered upon the enterprise of the conquest of France, which forms nearly the whole history of his reign. The claim which he advanced to the French crown was the same that had been put forward in the preceding century by Edward III., to whose rights he seems to have regarded himself as the legitimate successor in virtue of his possession of the throne, although he was certainly not the heir of that king by lineal descent. Henry, having appointed his brother, the Duke of Bedford, regent of the kingdom during his absence, set sail from Southampton, 13th August, 1415, with a force of 24,000 foot and about 6500 cavalry in a fleet of from 1200 to 1400 vessels, and on disembarking immediately proceeded to lay siege to the strong and well-garrisoned fortress of Harfleur. It capitulated after a siege of six weeks, in the course of which time, however, a dysentery that broke out in the camp made frightful havoc among the English.

On the 6th of October Henry set out on a rapid march through Normandy with the intention of reaching Calais, there to embark for England, with a force which could not have exceeded 9000 men. On the 24th, having crossed the Somme and when drawing near Montreuil, he came in sight of a French army, commanded by the Constable of France and the dukes of Orleans and Bourbon, the strength of which has been variously estimated at from 50,000 to 150,000 men. The great battle of Agincourt was fought on the next day, in which the English gained one of the most complete as well as skilful victories on record. Henry returned to England immediately after, and having received ample supplies again landed in France in August, 1417, with a magnificent army of about 35,000 men. The result of this expedition was the treaty of "Perpetual Peace," signed at Troyes, by which all Henry's demands were agreed to, namely—the hand of Charles's eldest daughter, the Princess Catharine, the present regency of the kingdom, and the succession to the throne of France on the death of Charles. He soon after set out with his queen for England, and on the 2nd of February, 1421, entered London amid such pageants and popular rejoicings as that capital had never before witnessed. In the course of the same year Henry led another army into France to resist the aggressions of the dauphin, when his arms met with their customary success. But the end of his triumphant career was now at hand. The dauphin and the Constable Buchan having laid siege to the town of Cosne, Henry, though ill at the time, set out to relieve that place, but was unable to proceed further than Corbeil, about 20 miles from Paris, when, resigning the command to his brother the Duke of Bedford, he was carried back in a litter to the Bois de Vincennes, in the vicinity of the capital, and there, after an illness of about a month, he breathed his last on the 31st of August, 1422, in the thirty-fourth year of his age and the tenth of his reign. Henry had but little trouble with his Parliaments, for the splendour of his victories induced them to grant him lavish supplies; but an important advance was made during his reign by the House of Commons, which successfully asserted the principle that no law should have force without its consent. The persecution of the Lollards, commenced by his father, was continued by Henry, and many of them were burned or hanged during his reign. The powerful Lord Cobham, a friend of the king under his former rank as Sir John Oldcastle, threw open his castle to the Lollards. He was flung into the Tower, but escaped and continued to defy the bishops and the king's officers. Eventually he was executed by the barbarous method of being hung in chains alive, and roasted by a fire kindled beneath his feet. Curiously enough Shakspeare was charged by the Puritans of Elizabeth's day, successors of the Lollards, with having burlesqued Sir John Oldcastle in the character of Falstaff, and we find in the second part of "Henry IV." the poet's emphatic disclaimer, "For Oldcastle died a martyr, and this is *not the man*."

HENRY VI., KING OF ENGLAND., surnamed *of Windsor*, was born 6th December, 1421, being the only issue of Henry V. by his queen, the Princess Catharine of France. He was not quite nine months old when the death of his father left him King of England. The actual administration of affairs in England was intrusted to the younger of his two uncles, Humphrey, duke of Gloucester, as substitute for the elder, John, duke of Bedford, who was appointed president of the council, but who remained in France, taking the late king's place as regent of that kingdom.

The history of the earlier and longer portion of this reign is the history of the gradual decay and final subversion of the English dominion in France. The death of Henry V. was followed in a few weeks (22nd October) by that of his father-in-law, Charles IV. Immediately on this event the dauphin was acknowledged by his adherents as Charles VII.; and Henry VI. was also proclaimed in Paris, and wherever the English power prevailed, as King of France. The next events of importance that occurred were the two great victories of Crevant and Verneuil obtained by the English over the French and their Scottish allies, the former on the 31st of July, 1423, the latter on the 17th of August, 1424.

The extraordinary succession of events that followed—the appearance of Joan of Arc on the scene; her arrival in the besieged city of Orleans (29th April, 1429); the raising of the siege (8th May); the defeat of the English at the battle of Patay (18th June); the coronation of King Charles at Rheims (15th July); the attack on Paris (12th September); the capture of Joan at Compiègne (25th May, 1430); her trial and execution at Rouen (30th May, 1431)—all belong to the singular story of the heroic maid. See ARC, JOAN OF.

The young King of England, now in his ninth year, had in the meantime been brought to Rouen (May, 1430), and was about a year and a half afterwards crowned at Paris (17th December, 1431). In 1435 the Duke of Burgundy concluded a peace with Charles, and a few days after the Duke of Bedford died. This event gave the finishing blow to the dominion of the English in France. In April, 1436, the English garrison in Paris was compelled to capitulate. In 1444 a truce was agreed upon, to last till 1st April, 1446; and in this interval a marriage was arranged between King Henry and Margaret, the beautiful daughter of René, king of Sicily and Jerusalem, and duke of Anjou, Maine, and Bar. In return for the hand of his daughter, he demanded the restoration of his hereditary estates of Maine and Anjou, which were in the possession of the English, and the proposal was at length assented to. The connection seemed to be one thoroughly French in spirit, and it is no wonder that the Earl of Suffolk, by whom it had been negotiated, became from this time the object of much general odium and suspicion. The first remarkable event that followed was the destruction of the Duke of Gloucester, who, although he appears not to have openly opposed the marriage, was certainly the most formidable obstacle in the way of the complete ascendency of Suffolk and the queen. Having been arrested on a charge of high treason, 11th February, 1447, he was on the seventeenth day thereafter found dead in his bed. His death was generally attributed to the agency of Suffolk, who now, raised to the dignity of duke, became ostensibly, as well as really, prime or rather sole minister.

Soon after, hostilities were renewed in France, and a numerous force having been poured by King Charles into Normandy, town after town was speedily reduced; Rouen, the capital, surrendered 4th November, 1449; and the fall of Cherbourg, 12th August, 1450, completed the loss of the duchy. As this catastrophe became evident the public wrath fell upon its author, the Duke of Suffolk. He was banished from the kingdom, but was seized as he was sailing across from Dover to Calais, and being carried on board one of the king's ships, was there detained for a few days, and at last had his head struck off by an executioner, who came alongside in a boat from the shore, 2nd May, 1450. The murder of Suffolk was immediately followed by a popular insurrection demanding securities for better government. These, after some actual hostilities, were agreed to, but upon the insurgents retiring to their homes the "Complaint of the Commons of Kent" was shelved, and the Duke of Somerset, a Beaufort of the second generation, though one of the ministers impeached, quietly resumed the administration. [See CADE, JOHN.] Before the close of the following year the French, in addition to Normandy, had recovered all Guienne; and with the exception of Calais, not a foot of ground remained to England of all her recent continental possessions.

The remainder of the history of the reign is made up of the events that arose out of the contest for the crown, commonly called the Wars of the Roses (from the emblem of the House of York being a white rose and that of the House of Lancaster a red one), which eventually placed another family on the throne. Had the "Complaint of the Commons of Kent" been attended to, as was promised, we might have been spared the Wars of the Roses; for it was the plotting of Somerset (whose dismissal was agreed to) and his kindred the Beauforts, who thought to succeed the as yet childless king in spite of their illegitimacy, which roused into action the Duke of York. The duke's title was far superior to the king's own, but he would have probably waited patiently for time to bring him to his right. [See EDWARD IV.] In 1454 the king sunk into a state of mind amounting to absolute incapacity. By the beginning of the year 1455, however, he had recovered, and again took upon him the nominal administration of the government, which during his illness had been committed to the Duke of York, after a sharp struggle between him and Somerset for the office of "protector." York flung Somerset into prison on assuming power, but the first act of the king on his recovery (or rather, to be accurate, that of Queen Margaret in the king's name) was to throw down the glove by the restoration of Somerset to more than his former honours and authority. In the contest that soon ensued Henry was taken prisoner by the Earl of Warwick at St. Alban's, 23rd May, 1455, in which battle the Duke of Somerset was among the slain, and towards the end of that year the king was again declared to be in a state of incapacity. In a few months, however, Henry recovered his health, and the government was conducted by the queen in his name till his second capture at Northampton, 10th July, 1460, by the son of York, the young Earl of March (afterwards Edward IV.), in a victory so crushing as to enable his father for the first time openly to claim the crown. He summoned a Parliament for this purpose, and although he could not procure the deposition of Henry, to whom they had all sworn fealty, he succeeded in obtaining the promise of the crown at Henry's death, to the prejudice of the infant son lately born to him. The queen escaped with her son, and eventually made her way to Scotland. There she worked with a woman's persistence and a man's courage to revive the hopes of her party. She was rewarded by a Yorkshire rising, and still more by the capture of the Duke of York at Wakefield, 1460, and his execution amidst every conceivable insult. The queen now herself advanced into England. The victory obtained by Margaret over the turncoat Warwick at St. Alban's, 17th February, 1461, again liberated her husband; but after the unfortunate issue of the battle of Towton, 29th March, which established Edward IV. on the throne, Henry retired with the queen and their youthful son Edward to Scotland. When Margaret again invaded England in 1462, Henry was placed in the Castle of Hardlough in Merionethshire. In the spring of 1464 he was brought from Wales to join a new insurrection of his adherents in the north of England. After the two final defeats of the Lancastrians at Hedgley Moor, 25th April, and at Hexham, 15th May, the deposed king lurked for more than a year in Lancashire and Westmorland, till he was at last betrayed and seized at Waddington Hall, in Yorkshire, in June, 1465. He was immediately conducted to London, and consigned to the Tower, where he remained in close confinement till a revolution under Warwick (the King-maker), who had yet again changed sides, in October, 1470, restored him for a few months to both his liberty and his crown. He was carried from London to the battle of Barnet, fought 14th April, 1471, and there fell once more into the hands of Edward, who immediately remanded him to the Tower. The old king survived the final defeat of his adherents, the capture of his queen, and the murder of his son, at Tewkesbury, 4th May. A few days after an attempt, which nearly succeeded, was made by Thomas Nevil, called the Bastard of Falconberg, to break into his prison and carry him off by force. This probably determined Edward to take effectual means for the prevention of further disturbance. All that is further known is that on the 22nd of May, 1471, the dead body of Henry was exposed to public view in St. Paul's. It was generally believed, however, that he had been murdered by the king's brother, the Duke of Gloucester, afterwards Richard III. Undoubtedly these awful troubles of England were largely due to the weakness of mind of the poor man who bore nominally the title of King Henry VI., but who served merely as a puppet for ambitious men and an ambitious woman to handle. But this weakness of mind we now clearly see to have been the result of the deliberate act of Henry V. In marrying Catharine of France it is true he secured the succession of France and England to the child of his marriage with one hand, but with the other, by his union with a madman's daughter, he

caused this child to be also a madman, who lost both the French crown and the English.

HENRY VII., KING OF ENGLAND, was born at Pembroke Castle, 21st January, 1456. His father was Edmund Tudor (or rather Tydor: pronounced Tuddor—that is, Theodore), surnamed *of Hadham*, who had been created Earl of Richmond in 1452, being the son of Sir Owen Tudor and Queen Catharine, widow of Henry V. He was thus paternally descended both from the royal house of France, and also, it is said, from the ancient sovereigns of Wales. But it was his maternal extraction that gave Henry Tudor his political importance. His mother was Margaret, the only child of John Beaufort, duke of Somerset, whose father, of the same name, was the eldest of the sons of John of Gaunt, duke of Lancaster, the root of the Lancastrian house, by his third wife, Catharine Swynford. Edmund Tudor died in 1456, a few months after the birth of his son, leaving the infant earl to the care of his mother, a noble-minded and accomplished woman. During the stormy period that followed the child found a protector in his uncle, Jasper Tudor, earl of Pembroke, who took him to Britanny, where, though honourably treated, both uncle and nephew remained under duress for several years. The crimes of Richard III. having excited universal detestation in England, the way was opened for the advent of Henry, and after one unsuccessful attempt in 1483, he landed on the 7th August, 1485, at Milford Haven, in Wales. The two rivals encountered at Bosworth in Leicestershire, on the 22nd, when Henry obtained a complete victory, which, with the death of Richard, who fell in the battle, at once placed the crown on his head. [See RICHARD III.] Henry married Elizabeth, the daughter of Edward IV. and the heiress of the rights of the house of York, 18th January, 1486.

It was not to be expected that a reign commenced in such circumstances should be undisturbed by insurrectionary attempts. The first that occurred was headed by Francis, viscount Lovel, in April, 1486, which was speedily and effectually put down. Before the end of the same year, however, a new and more formidable commotion was excited by the imposture of the boy Lambert Simnel, the son of a joiner at Oxford, who was put forward as Edward Plantagenet, earl of Warwick, the son and heir of the late Duke of Clarence, brother of Richard III. The brief royalty of Simnel, however, was terminated, 16th June, 1487, by the defeat of his adherents in the battle of Stoke, and Simnel was contemptuously given the post of a scullion in the royal kitchen. This imposture was followed after some years by the appearance of the more celebrated pretender Perkin Warbeck, who was asserted by his adherents to be Richard, duke of York, the younger brother of Edward V., and generally supposed to have been murdered along with him in the Tower. Warbeck arrived in Ireland from Lisbon in the beginning of May, 1492, and was afterwards acknowledged as Duke of York, or rather as Richard, king of England, not only by the Duchess of Burgundy, sister of Edward IV. and the dead duke's aunt, but by the governments both of France and Scotland. The King of Scotland, James IV., supported the cause of Warbeck with some enthusiasm, for he consented to his marriage with a daughter of the Earl of Huntly, and raised an army for the invasion of England. The invasion, however, met with no success, and Warbeck, after various adventures, was captured by the king in 1497. Another pretended Earl of Warwick next arose, one Ralph Wulford, or Wilford, the son of a shoemaker, whose attempt, however, was immediately nipped in the bud by his apprehension and execution in March, 1499. The same year in which Wulford was put to death witnessed the execution of Perkin Warbeck. From this time Henry's reign was one of complete internal tranquillity, of which he chiefly took advantage to augment his revenue and his hoarded treasures. In the latter pursuit he displayed insatiable avarice, and by means of renewing old and dormant claims of the crown, and by prosecutions for offences punishable by fine, he acquired immense sums of money. In his extortions he was assisted by two lawyers of infamous memory, Empson and Dudley, judges of the exchequer, whose severe sentences he commuted on payment of heavy fines, and who appear to have been utterly unscrupulous in their collection of plunder for the king. In his foreign policy he was resolute in his maintenance of peace, and though he was forced by the public opinion of England to make war upon France for the recovery of Britanny he contrived to pocket the surplus granted, and when he conducted his army to France in 1492 he had already secretly arranged a peace with Charles, and before there was any fighting the treaty was published in the beginning of November. By this treaty, called the treaty of Estaples, Charles bound himself to pay Henry the sum of £149,000.

By successive truces with James III. and James IV., the peace with Scotland was preserved till 1495. After Warbeck's final discomfiture, however, in 1497, a new truce was concluded between the two countries; and this led in 1502 to a treaty of perpetual peace, cemented by the marriage of James with Henry's eldest daughter, the Princess Margaret—an important event which ultimately led to the union of the English and Scottish crowns. Nearly two years before this—namely, 14th November, 1501—a marriage had been solemnized between Henry's eldest son Arthur, prince of Wales, and Catharine, the fourth daughter of Ferdinand, king of Castile. Arthur, however, who was a prince of the highest promise, died within six months after this time; and then it was arranged that Catharine should be married to his surviving brother Henry. The marriage of Henry and Catharine proved still more momentous in its consequences than that of James and Margaret. The queen, Elizabeth, died 11th February, 1503, a few days after giving birth to a daughter; the death of Henry VII. took place at Richmond, 22nd April, 1509, in the twenty-fourth year of his reign and the fifty-third of his age.

HENRY VIII., KING OF ENGLAND, the second son of Henry VII., was born at Greenwich, 28th June, 1491. On the 1st November following he was created Duke of York, and in 1494 his father conferred upon him the honorary title of lord lieutenant of Ireland, Sir Edward Poynings being appointed his deputy. Henry was at first destined for the church, and he received accordingly a learned education. It was an age of learning—Greek was newly revived and the study of natural science began, the English drama arose and blank verse was invented. The world was newborn in truth, and well did men name this brilliant epoch the Renaissance, or Renascence. Henry VII. had been the patron of Erasmus and Colet. Henry VIII., by the care of his father, was made one of the most accomplished scholars of the time. Lady Jane Grey, Queen Elizabeth, and Mary Queen of Scots were all learned ladies. Edward VI. injured his health by study.

Very soon after Arthur's death the singular project was started of marrying Henry to his brother's widow. The proposition appears to have originally come from Ferdinand and Isabella, who were anxious to retain the connection with England, and to have been assented to by Henry VII. in great part from his wish to avoid the repayment of the dower of the princess. The final agreement between the two kings was signed 23rd June, 1503.

Henry became king 22nd April, 1509, being then in his nineteenth year. One of the earliest proceedings of the new reign was the trial and punishment of the informers and spies of the last few years, including also Dudley and Empson, chief of the ministers of the rapacity of Henry VII., who, when he died, by their means or by means of others as vile, was found to have amassed the sum of £1,800,000, an incredible amount considering the value

of money in those days. They were indicted on the absurd charge of a conspiracy to take possession of London with an armed force during the last illness of the late king, and were beheaded together on Tower Hill, 17th August, 1510. Henry's accession marked the sun-burst of the glorious Renaissance, as has been said. To the three old, crafty, intriguing, peace-loving, miserly kings, Henry VII., Louis XII. of France, and Ferdinand of Spain, succeeded almost all at once, as in a brilliant transformation, the three young sovereigns, full of life and rivalry, and all eager for splendour and adventure, Henry VIII. (1509), Francis I. (1515), and Charles I. (1516), the last becoming Charles V. of Germany in 1519. As for Henry his people simply idolized him in his young days. Manly and beautiful in person beyond all his contemporaries; noble and kingly in his thoughts, words, and actions; a most scrupulous observer of his religious duties; learned and devout; gracious and magnificent above all sovereigns of his time, yet with all his love of courtliness and splendour never forgetting the man in the trappings of the monarch—there was no one who in all respects so completely realized to Englishmen their ideal of a king. It is not strange that almost to the very last of a reign that had become a tyranny they were unwilling to be undeceived—that it was long before they would admit the existence of glaring faults and vices, which, undeveloped in his youth and controlled by better influences, were strongly and sharply manifested in maturer years. Racked and distressed by the Civil Wars, accustomed to the severe, precise, and suspicious rule of Henry VII., England suddenly sprang into new life upon the accession of Henry VIII. Gayest among the gay, the head and centre of the brilliant throng by whom he was surrounded, the young king mixed freely as no sovereign had ever mixed with his people, and, fond of popularity, was popular with all classes as no king had ever been. Loyalty was not a duty, but a fascination. When Henry and Charles and Francis were striving for the crown of the Empire of Germany, at the death of Maximilian in 1519, England took part in the contest with all her heart. Wolsey says of the electors. "They will do well to choose the King of England, which is of the Germany tongue," in preference to a Spaniard or a Frenchman. And when the Spanish Charles was elected the English nation throbbed with angry disappointment.

Turning back to the chronological course of events, Henry had not been long upon the throne when he was induced to join what was called the League of Malines, formed against France by the pope, the Emperor Maximilian, and Ferdinand, king of Spain. In 1513 Henry passed over to France with an army, and, having been joined by the emperor, defeated the French, 4th August, at Guinegaste, in what was called the "battle of the spurs," from the unusual energy the beaten party are said to have shown in riding off the ground, and took the two towns of Terouenne and Tournay. On the 9th of September, also, the Scottish king, James IV., who as the ally of France had invaded England, was defeated by the Earl of Surrey in the great battle of Flodden Field, he himself with many of his principal nobility being left dead on the field. This war with France, however, was ended the following year by Louis XII., who was in his fifty-third year, wedding Henry's sister Mary, as yet only in her sixteenth year, 9th October, 1514. Louis died within three months, and his young widow then gave her hand to Charles Brandon, duke of Suffolk, an alliance out of which afterwards sprang a claim to the crown. See Grey, Lady Jane.

Thomas Wolsey, who had risen from the burgher class to become dean of Lincoln, was at this time brought forward by Fox, bishop of Winchester, to counteract the growing ascendency of his rival, the Earl of Surrey, and speedily made good for himself a place in the royal favour that reduced all the rest of the king's ministers to insignificance, and left in his hands for a long course of years nearly the whole executive power of the state. See Wolsey.

Notwithstanding his great disappointment over the imperial crown, Henry remained at peace both with the new Emperor Charles V. and with Francis. Francis sought to gain Henry, and met him in that splendid camp near Guisnes, 1519, celebrated under the name of the "Field of the Cloth of Gold." But before the close of the following year Henry, won over by Charles, who visited him at Southampton and urged him to claim his ancestral French territories, joined in the league with the emperor and the pope; and in March, 1522, declared war against France. Henry earned at this time the title of "Defender of the Faith," bestowed upon him by Pope Leo X. for a Latin treatise which he had published "On the Seven Sacraments," in confutation of Luther.

Before this date two domestic occurrences took place that especially deserve to be noted. The first of these was the execution, in 1513, immediately before Henry proceeded on his expedition to France, of Edmund de la Pole, duke of Suffolk, whose mother was Elizabeth Plantagenet, sister of Edward IV. He was now put to death without any form of trial or other legal proceeding—his crime, there can be no doubt, being merely his connection with the House of York. In 1521 Edward Stafford, duke of Buckingham, son of the duke beheaded by Richard III., was apprehended on some information which was furnished to Wolsey by a discarded servant, and, being brought to trial, was found guilty and executed as a traitor. The hasty speeches and injudicious acts with which he was charged did not, according to law, amount to treason, even if they had been proved.

Both these acts of tyranny, showing, as if in a prophecy, the temper of the king as it was one day to become, have for centuries been laid to Wolsey's charge. In the recent collections of the Rolls Series, Professor Brewer shows, however, from original papers in the state archives, that it was Henry himself who urged on the trial of the duke. He shows also that not only was Henry's pride touched, but that the duke's wealth excited his avarice. In fact, the true character of Wolsey is shown in its greatness by the rapid deterioration of the king's character after he had lost him. Thus, under the three years of the chancellorship of the gentle More, more blood was spilt than under the twenty years of the proud cardinal. Wolsey, on the other hand, is to be credited with the awful responsibility of the establishment of the Tudor tyranny; if in his hands it was a mild despotism, it was he who made it despotic, and to whom we must charge its cruel power when the mildness was no longer. His admiration for the king was a passion; his power of work almost unequalled; his diplomacy in preserving peace, and so avoiding the necessity of calling many Parliaments, which he dreaded by instinct, of bowing to them when they were called, or of hearing denounced his and his master's illegal taxation, was never equalled save by Elizabeth, who indeed learned the trick from him.

Henry had married the widow of his brother by papal dispensation. The dynasty was new, the land was profoundly disturbed, child after child of the union had died, and only a sickly girl (Mary) survived as heir to a throne which a Wolsey and a Henry (nearly Wolsey's equal) found it task their whole strength to maintain. Lured on by his eagerness for a male heir, and knowing from his theological studies that he had committed a crime from which all the dispensations in the world could not absolve him, Henry followed the whispers of his people, and began to see, as they saw, the anger of God at his marriage with Catharine of Aragon. He determined to obtain a divorce; and Wolsey warmly seconded his view, for the queen had thwarted his policy most dangerously by her Spanish instincts. But it was necessary to move warily,

for Charles V., who was now at the summit of his fame, controlled all continental Europe, including the pope himself, and Charles was the nephew, and as far as was possible to his cold nature the affectionate nephew, of Catharine. Wolsey's distress may be imagined when Henry abruptly informed him, in 1527, that he proposed to marry Anne Boleyn, one of the queen's ladies. Anne, it was well known, was inclined to the new Protestant heresy, the pope and the emperor were as yet wholly ignorant of the proposed divorce, and Wolsey remonstrated accordingly. He was never forgiven by the king nor by Anne; the latter ceaselessly worked against him. On the other hand, in a desperate attempt to regain the king's goodwill, he pushed on proceedings for a divorce, and had to receive the pathetic and bitter reproaches of the queen. The proceedings dragged on for months, and finally Clement VII., at his wit's end between the two powerful monarchs Henry and Charles, cited the case to Rome. Henry, furious, yielded now to Anne's solicitations, and banished Wolsey from court. This was followed by a prosecution for holding his court as papal legate in England, an offence of *præmunire.* Wolsey gave up all he possessed, offices, palaces (Hampton Court and York Place, or Whitehall), colleges (Christ Church, Oxford, then called Cardinal College), money, and jewels. He was pardoned at this cost, and retired to Esher, and thence to his archbishopric of York (1529). His enemies next year trumped up a charge of high treason, and he was arrested. He never was guilty of the impertinence, frequently charged upon him by the ignorance or carelessness of historians, of writing *Ego et rex meus*, and the real charge which made the foundation of his arrest for high treason was simply that "the king's name and his own had been used in conjunction," as if he aspired to some sort of equality. He had written "The king and I," and that was held sufficient to send him to the block, had not the king of his great grace accepted his entire ruin as a substitute, involving his broken heart and his death. This base ingratitude of Henry to his most faithful servant was undoubtedly at the direct personal instigation of Anne Boleyn. Wolsey died at Leicester, on his way to the Tower, repenting of his work in creating the monster which had devoured him, in the famous words, "Master Knyghton, had I but served my God as diligently as I have served my king, he would not have given me over in my gray hairs."

Henry is said to have been blinded by his fondness for Anne Boleyn, and certainly it was a shameful insult to a virtuous if an elderly, plain-visaged, ill-tempered, and meddlesome wife, to have her proclaimed successor treated like a queen while her own divorce was not yet pronounced. But it is the gravest mistake to think that Henry acted knowingly an evil part. His relations with Anne were open and very rigidly restrained, and it was six years after the divorce proceedings had begun before his secret union with her in January, 1533. Certainly here is no hot haste. A few years more, and a change of wives happens again. We cannot even now be sure whether Anne had become guilty, but we know that Henry honestly thought her so, and can see that this was possibly because (having learned to know the virtues of Jane Seymour) he so earnestly *desired* to think her so. "The wish was father to the thought." As a psychological study the character of Henry is indeed of engrossing interest. The old view of him as a mere sensual tyrant, and the wholly apologetic view of the historian Froude of our own time, are equally wide of the mark. It is a history and a study which has yet to be written, and to which the labours of Professor Brewer, among the national *paperasses* ("Reign of Henry VIII.," London, 1884), have contributed new material of untold value.

The fall of Wolsey threw the power into the hands of probably the most extraordinary statesman England was ever ruled by, Thomas Cromwell. Wolsey had built up the Tudor despotism, Cromwell carried it out. He gained Henry's notice by his sturdy efforts to help Wolsey, his patron, in his disgrace, and his favour by his bold suggestion to the king to assume the supremacy of the Church in England, and so to cut the knot of the question of divorce by annulling for ever the authority of the pope and settling it in his own court. His friend Thomas Cranmer, a scholar of Cambridge, also came forward with a suggestion to consult the universities of all Europe, much to Henry's liking; but the English universities, under heavy pressure, and the French University of Paris by order of the King of France, alone replied favourably.

In January, 1531, the first blow was struck at the church by an indictment being brought into the King's Bench against all the clergymen of the kingdom for having supported Wolsey in the exercise of his legatine powers without the royal license, and it was in an Act passed immediately after by the Convocation of the Province of Canterbury, for granting to the king a sum of money to exempt them from the penalties of their conviction on this indictment, that the first movement was made towards a revolt against the see of Rome, in the titles given to Henry of "the one protector of the English Church, its only and supreme lord, and, as far as might be by the law of Christ, its supreme head." Shortly after the convocation declared the king's marriage with Catharine to be contrary to the law of God. In August, 1532, Cranmer was appointed to the archbishopric of Canterbury. In the beginning of the year 1533 Henry was privately married to Anne Boleyn; and on the 23rd of May following Archbishop Cranmer, in his new ecclesiastical court, pronounced the former marriage with Catharine void, and very soon afterwards publicly crowned Anne. In the meantime Parliament had passed an Act forbidding all appeals to the see of Rome. Pope Clement VII. met this by annulling the sentence of Cranmer in the matter of the marriage, on which the separation from Rome became complete. Sir Thomas More, a liberal but earnest Catholic, and for the last three years chancellor, now quietly retired from the king's service. Acts were passed by Parliament the next year declaring that the clergy should in future be assembled in convocation only by the king's writ, that no constitutions enacted by them should be of force without the king's assent, and that no first-fruits, nor Peter's-pence, nor money for dispensations should be any longer paid to the pope. In the next session Parliament, which reassembled at the end of the same year, passed Acts declaring the king's highness to be supreme head of the Church of England, and to have authority to redress all errors, heresies, and abuses in the church. After this various persons were executed for refusing to acknowledge the king's supremacy—among others, two illustrious victims, the learned Fisher, bishop of Rochester, and the admirable Sir Thomas More. Cromwell was appointed vicar-general, that is to say, the king's minister in ecclesiastical affairs. He began by "tuning the pulpits," and the bishops were made responsible for the new doctrines of supremacy and separation being duly preached upon the heads of sermons sketched by Cromwell himself. Finally, in 1536 Henry himself drew up articles of religion, based on the Bible and the three creeds, which were at once accepted by convocation. The sacraments were reduced from seven to three. Transubstantiation was affirmed, but on the other hand justification by faith was allowed. Prayers for the dead were encouraged, but the belief in purgatory was rejected. The creed, the Lord's prayer, and the ten commandments were translated into English and ordered to be taught by every father to his children; and Miles Coverdale collected the translations of Tyndal, revised them, and published the Bible in English with the sanction of Henry himself, 1537. Two years later Cranmer reproduced this,

with revisions, as the "Great Bible," a translation of much beauty, regarded as melodious prose, and still used in our Prayer-book, though as a whole King James' Bible, our Authorized Version, replaced it in all ordinary church services. In 1535 began the dissolution of the monasteries, under the zealous superintendence of Cromwell. We may admit that they were hopelessly corrupt, but nevertheless their dissolution claimed that something should replace them. Their wealth, part of which had been spent on the people, Henry shared among his courtiers, and the poor suffered great misery.

Events now set in a new current. The month of May, 1535, witnessed the trial and execution of Queen Anne —in less than six months after the death of her predecessor, Catharine of Aragon—and the very next morning saw the marriage of the king to Jane Seymour. Queen Jane dying on the 14th October, 1537, a few days after giving birth to a son (afterwards Edward VI.), was succeeded by Anne, sister of the Duke of Cleves, whom Henry married formally in January, 1540, and in six months afterwards equally formally divorced. A picture by Holbein had led him to consent to an union which so well suited Cromwell's Protestant policy. When he privately saw the princess, who was very ugly and could speak not a word of anything but Dutch, Henry refused ever to meet her, and Cromwell was a marked man. Anne retired to Bletchingley, in Surrey, and lived peaceably and comfortably upon a fairly handsome provision till her death. The remains of her residence still exist at the *Place* (*i.e.* Palace) Farm there.

In 1539 the Parliament, after enacting (by the 31 Henry VIII. c. 8) the law, incredible now to English minds, that the proclamation of the king in council should henceforth have the same authority as a statute, passed the famous Act (31 Henry VIII. c. 14) known by the name of the Six Articles, or the Bloody Statute. This statute, the cause of numerous executions, even of abbots in their robes, with many noblemen and gentry, was to crush the principles of the rising called the *Pilgrimage of Grace* (1536), and promulgated the following points of necessary faith—(1) real presence; (2) communion in one kind only; (3) perpetuity of vows of chastity; (4) utility of private masses; (5) celibacy of the clergy; and (6) confession. So that Catholics now informed against Protestants and Protestants against Catholics, and the same fire burned the one for denying the real presence that burned the other for denying the king's supremacy. Cromwell was at this time ruling by sheer terror, the land was one mass of spies, and heads fell at the slightest opposition. But his whole power rested upon the king, who grew more arbitrary every day. His disgust in the matter of Anne of Cleves fanned the flame of his impatience with the remonstrances of Cromwell, Cranmer, and the Protestant party against the law of the Six Articles; and suddenly Henry granted leave to Norfolk, one of Cromwell's many bitter enemies, to arrest him for heresy and high treason, charges utterly futile and absurd. The proceedings were pushed forward step by step with the Cleves divorce. Cromwell had thought to strengthen his hands by a law that permitted a man to be condemned in attainder in his absence. This was for the first and only time put into force in his own case. He was flung into the Tower, 1540, a few weeks only after he had become Earl of Essex and lord high chamberlain, and on 28th July was beheaded on Tower Hill. Among the last of the fearful state crimes of this ruthless man was the execution of Margaret, countess dowager of Salisbury, the daughter of the late Duke of Clarence, and the last of the York Plantagenets. Her real crime to Cromwell was that she stood at the head of the old feudal nobles, and to his master that she was the mother of Cardinal Pole, who had offended the tyrant, and who was himself beyond his reach. Courtenay, marquis of Exeter, another Plantagenet, grandson of Edward IV., perished for a hasty word against Cromwell at the same time. He had been heard to say, "Knaves rule about the king."

In the latter part of the year 1542 war was declared by Henry against Scotland on account of its Catholic policy. The young King James V. was defeated at Solway Moss, and died broken-hearted, leaving only a little girl as heir to the crown. The failure of Henry's efforts to obtain control of the Scotch government and marry the young queen, Mary Stuart, to his son Edward, led to a renewal of hostilities in the spring of 1544, when Scotland was invaded by a great army under the Earl of Hertford, which penetrated as far as Edinburgh, and burned that capital, with many other towns and villages. In the preceding year, also, Henry had concluded a new alliance with the emperor against the French king; and in July, 1544, he passed over with an army to France, with which he succeeded in taking the town of Boulogne. On this, however, the emperor made a separate peace with Francis; and on the 7th of June, 1546, Henry also signed a treaty with that king, in which he agreed to restore Boulogne and its dependencies in consideration of a payment of 2,000,000 crowns.

In August, 1540, Henry married Catharine Howard, who was of light conduct. She was justly convicted of high treason and beheaded in February, 1542. In about a year he found a sixth wife, Catharine Parr, the widow of Lord Latimer, whom he married 10th July, 1543, and who survived him, though at one time articles of impeachment were actually prepared against her by the king's order as a heretic. The queen got intelligence of it, and at once protested her Protestantism was but feigned to give Henry the pleasure of so triumphantly confuting her. The chancellor had actually come to convey her to the Tower when her dexterity thus turned the king's purpose (Foxe). As the infirmities of age and disease grew upon him, the suspiciousness and impetuosity of his temper acquired additional violence. One of his last butcheries was that of Henry Howard, earl of Surrey, who, being convicted of treason, was executed 19th January, 1547. Surrey's father, the Duke of Norfolk, was also to have suffered on the 28th, but was saved by the death of the king at two o'clock on the morning of that day.

Henry was empowered by Parliament to fix the succession. His will named Prince Edward his successor, with remainder to the princesses Mary and Elizabeth, in that order, and removed the brand of illegitimacy from them which he, though their father, had cast upon them. Failing issue of all these (the case which did really happen) Henry declared that the crown should pass to the descendants of his sister Mary (that is to say, to Lady Jane Grey, &c.), instead of the undoubted heiress in that event, the young Mary Queen of Scots.

The most important changes made in the law during this reign were those affecting ecclesiastical affairs, and of these the principal have been already noticed. Along with them may be mentioned the statute defining the degrees within which marriage should be lawful (25 Henry VIII. c. 22). The law of real property was also materially affected by the Statute of Uses (27 Henry VIII. c. 10), and by the statutes which permitted the devise, which was not before allowed, except by the custom of particular places, of real estates by will. To this reign is also to be assigned the origin of the bankruptcy laws. Wales was first incorporated with England in the twenty-seventh year of Henry VIII.; and Ireland, which before was styled only a lordship, was in 1542 erected into a kingdom. (Froude's "History of England, from Wolsey to Elizabeth," London, 1869; Green's "Short History of the English People," London, 1876; Brewer's "Reign of Henry VIII., to the Fall of Wolsey," London, 1884.)

HENRY IX. OF ENGLAND. In the crypt of St. Peter's at Rome (*sagre grotte del Vaticano*) is a plain stone coffin

bearing this inscription, "D. O. M. Henricus IX., Jacobi III., Magnæ Brittaniæ, Franc. et Hib., regis filius, Dux Eboracencis, nuncup, Epūs Ostien. et Velitern. S. R. E. Vice-cancellar, S. Coll. Decanus, SS. Basilicæ Vatican. archipr. Tusculi obiit die xiii. jul. an. MDCCCVII. Vixit an. LXXII, m. IV, d. VII." It is the tomb of "King Henry IX." of England, son of "King James III." of Great Britain, France, and Ireland, &c., who is better known to us as the Old Pretender; and "King Henry IX., Duke of York, nuncio, Bishop of Ostia, &c., vice-chancellor, dean of the College of Cardinals, arch-priest of the Vatican Basilica," &c., is the lovable and beloved Cardinal York, the last of the Stuarts. He sleeps here after his life of seventy-two years four months and seven days, which ended at Tusculum; and near by are the tombs of his father, "James III.," and his brother, "Charles III." (The latter is Charles Edward, the Young Pretender.)

HENRY I. OF FRANCE, son of King Robert, succeeded his father in July, 1031, being then about twenty-seven years of age. Henry's younger brother Robert, supported by his mother and the counts of Champagne and Flanders, contended with him for the throne; but peace was made by Henry giving to Robert the duchy of Burgundy. Henry married, in 1011, Anne, daughter of Jaroslav, duke of Russia, by whom he had several sons, the eldest of whom Philip, was crowned at Rheims in 1059, at seven years of age, by order of his father, who died in the following year, leaving Philip I. under the guardianship of Baldwin, earl of Flanders.

HENRY II. OF FRANCE, was born in 1518; married Cathérine de Médicis in 1533, and in 1547 succeeded his father Francis I., whose advisers he immediately displaced, and whose accumulated treasures he quickly squandered among his mistresses. Soon after his accession he entered into an alliance with Scotland and commenced a war with England, which was terminated for a time in 1550, England consenting to abandon Boulogne for a payment of 400,000 crowns. Though he repressed Protestantism with fire and sword in France, he yet sent a considerable force to assist Maurice of Saxony and the German reformers in their struggle against the Emperor Charles V. Invading Lorraine he captured Toul and Verdun; and his general, the Constable Montmorency, through the treachery of the garrison, took possession of Metz. After the abdication of Charles V. in 1556, a truce was signed, but the division of his empire between his brother Ferdinand and his son Philip II. caused Henry to recommence hostilities, bnt with results disastrous to France. In Italy the efforts of François de Guise were foiled by the generalship of Alva, and in the low counties the French army, commanded by the Constable Montmorency, was utterly defeated by the Spaniards under the Duke of Savoy in the battle of St. Quentin, fought 10th August, 1557. In this defeat the French incurred a loss of 4000 men, and the constable himself was taken prisoner. In 1558 Calais, which had been in the possession of England for over 200 years, was recovered by France through the genius and energy of De Guise, and in 1559, by the peace of Château Cambresis, this town, with Ham, St. Quentin, and Castelet, were left in the possession of Henry, but he was compelled to resign most of his own conquests and those of his father Francis I., including 190 fortified places. At the same time a double marriage was concluded between his daughter Elizabeth and Philip II. of Spain, and between his sister Margaret and the Duke of Savoy. The festivals given on this occasion had a tragical end, for Henry was accidentally wounded at a tournament by the Count Montgomery, a Scottish nobleman and captain of his guard, the broken shaft of whose spear struck the king on the right eye, causing his death a few days afterwards, 10th July, 1559. He had four sons by his wife, Cathérine de Médicis, the eldest of whom succeeded him as Francis II.

HENRY III. OF FRANCE, the third son of Henry II. and Cathérine de Médicis, was born at Fontainebleau in 1551. He was placed at the head of an army at the age of sixteen, and his first campaign was signalized by the two important victories of Jarnac and Moncontour, gained over the Huguenots. In 1573 his mother succeeded by her intrigues in procuring his election to the throne of Poland as the successor of Sigismund Augustus, and he was crowned at Cracow the same year. Both king and subjects soon became tired of each other, and when after a reign of a few months Henry heard of the death of his brother, he at once left Poland in hot haste, leaving Cracow secretly and by night in June, 1574. On reaching France he was proclaimed king of that country under the title of Henry III. He continued the civil war that had been commenced between the Catholics and the Huguenots; but alarmed by the growing power of the latter, he obtained a temporary peace by granting liberty of worship and several other rights that had been claimed. This exasperated the Catholics, and Henry soon found he was trusted by neither party. Alternately ostentatious in his extravagant devotion, and cynically and openly shameless in the practice of debauchery, he soon lost all personal popularity, while his chief favourites were as abandoned and unworthy as himself. In the outbreak of civil war, known as the war of the three Henrys, in which the Catholic leaguers were led by Henry of Guise and the Huguenots by Henry of Navarre, the king soon found his party the weakest of all, and he was driven from Paris by an insurrection of the populace in 1588. A seeming reconciliation with the Duke of Guise afterwards took place, but Henry, who had resolved on his death, caused him to be murdered, 23rd December, 1588. This act of treachery, however, only added to his difficulties, for Paris declared the king had forfeited his throne, most of the great towns of France rebelled, and the pope excommunicated him. In this emergency he threw himself upon the protection of Henry of Navarre, who joined him with his army, repulsed the Duke of Mayenne, the leader of the Catholic league, and the two kings at the head of 40,000 men marched upon Paris and besieged it. It was gallantly defended by Mayenne, but would probably have been obliged to capitulate when the course of events was changed by the action of a fanatical Dominican friar named Jacques Clement, who obtained admission to the king, and stabbed him through the body. Henry died the following day, 2nd August, 1589, and with his death the dynasty of the Valois, which had ruled France for 261 years, came to an end.

HENRY IV., KING OF FRANCE AND OF NAVARRE, was born at Pau in the Béarn, 15th December, 1553. He was the third son of Antoine de Bourbon and Jeanne d'Albret, only daughter of Henry d'Albret, king of Navarre, after whose death in 1535 Antoine became king of Navarre in right of his wife. He was carefully educated in the principles of Calvinism by his mother, and at the same time he was instructed in all knightly exercises, and inured to the simple, hardy, and frugal habits of his native mountaineers. In 1569 he was taken by his mother to La Rochelle and presented to the Protestant army there, and soon afterwards he took part in the battles of Jarnac and Moncontour. After the assassination of his uncle he was acknowledged as the leader of the French Protestants, though owing to his youth the veteran Coligny was intrusted with the virtual command of the forces. After the peace of 1570 he was invited with his mother to the French court, and a marriage was proposed between Henry and Margaret of Valois, the sister of Charles IX. His mother died suddenly 9th June, 1572, probably from the effects of poison administered by her enemies at the court, and Henry became king of Navarre. His marriage was celebrated with great pomp on the 17th August of the same year, and while the Protestants were thus lulled into

security, the arrangements for their massacre were completed, and were carried out on the eve of St. Bartholomew, within a week of the marriage. Henry's life was spared on his making a profession of Catholicism, but he was kept under close surveillance for about three years. In 1576 he made his escape from Paris and joined the Huguenots at Alençon, revoking his compulsory conversion and resuming the command of their army. In the prolonged contest which ensued, he displayed great courage and military talent, and gained such advantages as to induce Henry III. of France to conclude a peace making important concessions to Protestantism. This, however, gave great dissatisfaction to the Catholic party, and a Catholic league was formed which led to a renewal of the war. After the murder of the Duke of Guise the French king was compelled to seek the protection and assistance of Henry, and his assassination in 1589 left the latter, according to the Salic law, the rightful heir to the throne of France. His claims, however, were rejected by the Catholic party, who supported the Cardinal of Bourbon and appointed the Duke of Mayenne lieutenant-general of the kingdom. Henry repulsed an attack of the latter at Arques in October, 1589, and on 14th March, 1590, he gained the great victory of Ivry. The war was continued with varying success during the next three years, when Henry began negotiations with several of the leaders of the league, and was induced, in order to smooth matters, to make a public profession of the Roman Catholic faith at St. Denis, 25th July, 1593. In March, 1594, Paris opened its gates to him, and Rouen and other cities followed the example, and four years later, in 1598, peace was finally concluded with Philip II. of Spain by the treaty of Vervins. The same year was marked by the promulgation of the famous Edict of Nantes, which promised equal rights and liberty of conscience to his Protestant subjects, and then with the assistance of his able and sagacious minister De Rosny, afterwards Duke of Sully, the king applied himself to reform the administration of justice, to restore order to the finances, and to promote industry and commerce. In all these departments the most wonderful reforms were effected, and the king earned for himself the most devoted admiration and love on the part of his subjects. Towards the close of his reign he was busy in the elaboration of two great projects, one for the pacification of Europe by an arrangement that would put an end to the religious wars between the Roman Catholics and Protestants, and the other of reducing the power of the house of Austria. In the latter project he made immense preparations, but when about to set out he was assassinated by Ravaillac, 14th May, 1610, in the fifty-seventh year of his age and the twenty-first of his reign. Nineteen attempts had previously been made upon his life, all of which had been frustrated. Henry IV. is undoubtedly the most popular monarch that ever sat upon the throne of France. That he possessed numerous faults and was sadly lax in his morality is unhappily beyond disproof, but his great courage, high intellectual powers, vivacity, amiability, simplicity of manners, strong love of his country, and kindness to the poor, caused his memory to be long and fondly cherished by the French people.

HENRY I., EMPEROR OF GERMANY (or, to be pedantically accurate, of the HOLY ROMAN EMPIRE), otherwise called *Henry the Fowler*, was originally Duke of Saxony, and a great opponent of the Emperor Conrad. The latter at his death, however, having recognized the honourable nature of Henry's opposition while he, best of all men, understood his great worth, was magnanimous enough to recommend his foe to be his successor; and Henry was actually elected in 918. So little did he anticipate the honour that the messengers with news of his election found him engaged in hawking, whence his sobriquet of *the Fowler*. Henry was only emperor *in posse*, he never was able to get to Rome to receive the imperial crown. His actual position, to be precise, was not Emperor, but King of Germany. His great deeds were the defeat of the invading Hungarians at Merseburg in 933, the seizure of Lotharingia and its conversion into a German fief, his subjection of Bohemia and the neighbouring Slav countries, and his extension of frontiers at the Danish expense. Less brilliant, but more solid and enduring, were his constant endeavours at the maintenance and increase of order and security, especially by the foundation of new towns and the strengthening of old ones. One of his decrees compelled every ninth countryman by tale to go and live in the town nearest to him at the expense of the other eight, there to help in building or fighting. Every one was compelled, also, to lay by a third part of his produce in times of peace to be ready against days of need. Measures so rigorous, if necessary, show what wonderful power over his people Henry the Fowler possessed. Their confidence in him was rewarded by the quick growth of a powerful burgher class, a bulwark of liberty of inestimable value in later eras.

HENRY II., EMPEROR OF GERMANY; king in 1002, crowned emperor 1014; introduced the practice of indicating the claim of the kings of Germany to the Holy Roman Empire by calling himself King of the Romans, a custom always followed by his successors. He was a Duke of Bavaria and of kin to the Saxon dynasty of emperors. On the death of the last of that family, Otto III. (Wonder of the World) Henry of Bavaria became King of Germany, 1002; but it was fully a year before his supremacy was completely recognized. His reign was largely filled with expelling the Poles, under Boleslau Chrobry, from Bohemia and Saxony, which they had conquered. He was successful, but Boleslau proclaimed himself an independent King of Poland as soon as his great master died. Henry II. is often called *Saint Henry* because of his goodness to the church. He died in 1024.

HENRY III., EMPEROR OF GERMANY, one of the Franconian dynasty, succeeded his father Conrad II. as King of Germany at the age of twenty-two in 1039. He was crowned emperor at Rome in 1046. He was one of the most powerful of the mediæval sovereigns, put down the practice of private war, subdued the rebellious Hungarians and Bohemians, and even conquered the papacy itself, then claimed by three rival popes. He appointed in succession no less than four popes (all Germans), with as little ceremony as if they had been simply bishops. He died in 1056, bitterly regretted.

HENRY IV., EMPEROR OF GERMANY, was but six years old at the death of his father Henry III. His youth was passed partly with the Archbishop of Cologne, partly with the gay and brilliant Archbishop of Bremen. In 1065 he was declared of age to rule for himself, and his bad training at once showed itself in quarrels with the secular princes one after the other. The Saxons rose against him on his imprisoning their young duke on suspicion of treason, and he could find refuge only in the single town of Worms, where he fled before their advance. Had the Saxons been moderate in their conquest doubtless Henry would have been at their mercy, but their excesses were such as to rouse all Germany against them, and Henry soon found himself at the head of such a force as to enable him to gain the complete victory of Langensalza in 1075. It was now Henry's turn to be so foolish as to throw away the results of his conquest by too great harshness. Consequently when Gregory VII. began to insist upon Henry's obeying his decree condemning feudal investitures on the part of the clergy, and the emperor rightly enough resisted and defied the pope's excommunication, he found himself deserted by his vassals. He was wise enough, when the princes assembled at Tribur in 1076 and decreed that if he remained excommunicate during a year he should be deposed, to accept the position frankly. He at once

journeyed to Italy and submitted to the humiliating penance at Canossa, where the stern old pope, though it was a bitter winter time, forced him to stand bareheaded three days in the outer court before he would receive him again into the church. Rudolf of Swabia had meanwhile been elected King of Germany by several of the discontented nobles. Henry took up arms against him. The pope eventually recognized Rudolf and again excommunicated Henry. But the emperor was wiser and stronger now, and the weapon failed of its force. Henry replied to the excommunication by calling together the prelates of Germany, who at his instigation deposed Gregory and elected the Archbishop of Ravenna pope as Clement III. (1080). The same year also his foe Rudolf died in battle. In 1081 Germany was at his feet, and he was able to go to Rome to be crowned emperor by the anti-pope Clement III. in St. Peter's, Gregory still holding the fortress of St Angelo, where he was virtually a prisoner (1084). The approach of Guiscard and his Normans and the sack of Rome followed, and th emperor, retreating before Guiscard, left Italy during 1085. eHis authority had been thoroughly vindicated, and for some time he enjoyed much power both in Germany and North Italy. In 1091 his son Conrad was incited by Urban II., successor of Gregory VII. and inheritor of his quarrel with the empire, to rebel against his father; and in 1095 came those fearful charges against the emperor at the Council of Piacenza—charges preferred by his empress herself (his second wif·) of injuries and insults inflicted upon her own virtue at her husband's command—which are utterly incredible to us, and indeed unintelligible, except on the supposition of the poor lady's insanity. But the pope by means of them crushed not only Henry's Italian power, but the unhappy king himself for a time. He was with difficulty persuaded from falling on his sword. He returned to Germany, however, and gradually recovered his German authority, until by 1099 he was certainly more powerful than ever before. At this time he punished Conrad for his continued treason by the public recognition of his brother Henry as his successor, and it seemed as if his stormy life was about to close in peace. But unhappily, when the anti-pope Clement III. died, the emperor was so ill advised as not to take the opportunity to acknowledge the church-pope, Paschal II. Consequently, on his attempting to set up a new anti-pope Paschal excommunicated him and incited his son Henry to rebel against him. By treachery almost unparalleled Henry lured his father, who was very fond of him, into a castle, shut the gates upon him, and held him so close a prisoner that he could not obtain materials for shaving or for washing. When he eventually gained release his death almost at once followed (1106). His body lay in a stone coffin in an unconsecrated chapel at Spires till 1111, when the sentence of excommunication was withdrawn and it was properly buried.

Henry V., Emperor of Germany, succeeded his father. As might be expected from his perfidious treatment of his aged father—treatment defended by him on the necessity of forcing him to a reconciliation with the church—no sooner was he once firmly seated on the throne than he threw over his papal allies, and was as stern a foe to papal infringements of German liberties as was ever Henry IV. In 1110, at the head of a large army, he went to Rome and forced Paschal II. to submit and to crown him emperor. As soon as he departed he was of course excommunicated, and so the feud went on. But in 1122, when Calixtus II. had succeeded to the papacy, a compromise was agreed to and embodied in the famous Concordat of Worms. The bishops were to do feudal homage, but their appointment and ecclesiastical investiture were to remain with the pope. Certainly the pope had the advantage in this settlement. Henry died in 1125, after an unsettled and disturbed reign. He married Matilda, daughter of Henry I. of England; but he left no children, and in him the Franconian line of emperors ceased. After his death his widow married Geoffrey Plantagenet, count of Anjou, and became the mother of Henry II. of England.

Henry VI., Emperor of Germany, one of the Hohenstaufen or Swabian emperors, succeeded his father Frederick I. (Barbarossa) in 1190. The latter died in the Holy Land on a crusade, and on the news of his death Henry, crowned King of the Romans some years before, hastened to Italy to receive the imperial crown. He is interesting to us as being the sovereign into whose hands Leopold, duke of Austria, delivered Richard of the Lion-Heart, king of England, whom he held prisoner against an enormous ransom, and whom he forced, while in confinement (as William of Normandy did ages before to Harold Godwineson) to swear some kind of homage to him. The exact nature of this homage is not known, but it is generally thought to have been feudal homage of the crown of England. Be that as it may, so soon as the ransom was paid by the English people and Richard was free, there was no more question about this absurd homage. Henry VI. died in 1197. Although he failed in his endeavour to make the crown hereditary, yet his son eventually succeeded him as the famous Frederick II.

Henry VII., Emperor of Germany, was a count of Luxemburg chosen to succeed Albert I. at his death, because the electors were jealous of the power which Albert had managed to give to his own state of Austria. Henry married his son to the heiress of Bohemia, thus founding the long line of Luxemburg sovereigns of that kingdom. He seemed to be about to restore the empire to its former greatness. For one thing he revived the custom of Italian coronation. Henry of Luxemburg is, indeed, Dante's hero ("Purgatorio," xxxiii. 43, "Paradiso," xvii. 82, and xxx. 137). This descent of his in 1310 into Italy, so begged in vain of his father, stirred to its deepest the heart of the poet, longing for the unity of his distracted country, and hoping to attain it through the empire. He hastened to meet him, and urged him not to linger so long in Lombardy, but push forward to Florence. He himself went forward to prepare the way, and from thence wrote that remarkable epistle, "From the sources of the Arno, on the 14th May, 1311, in the first year of the happy journey of the divine Henry into Italy," which we still possess. He even cries in his ecstatic way, at the close of the letter, "Behold the Lamb of God who taketh away the sins of the world." Henry was the prince whom Dante had in his eye in the treatise "De Monarchiâ," of which Milman says ("Latin Christianity"), "Neither Dante nor his time can be understood but through this treatise." The "divine and triumphant Henry" did in fact make a splendid progress through Italy, was crowned with the iron crown at Lombardy and the golden crown at Rome (1312), and everywhere partially restored a long-lost order and authority. But he suddenly sickened and died at Buonconvento, 1312, and his end was universally attributed to poison administered by a Dominican monk in the sacrament, by order of the Avignon Pope Clement V., the emperor's secret enemy—the "Gascon who so cheated the noble Henry" (Dante's "Paradiso"). Dante, finishing the "Commedia Divina" at the close of his own life, depicts ("Paradiso," xxx.) the empty seat of Henry in highest Paradise as awaiting him already in 1300, the date given to the vision —depicts also the end of Clement V., who will be thrust head first on top of Boniface VIII. ("Inferno" xix.) when the latter has sunk sufficiently deep in Malebolge.

HENRY OF HUNTINGDON, an ancient English historian, the son of Nicholas, a married priest, was born about the end of the eleventh century, and was educated under Alcuin of Anjou, a canon of Lincoln Cathedral. He was made archdeacon of Huntingdon some time before 1123. He composed a general history of England, from

the earliest accounts to the death of Stephen, 1154, in eight books, published by Sir Henry Saville among the "Anglicarum Rerum Scriptores post Bedam" (folio, London, 1601). The exact time of his death is not known. There is a good English translation by Forester (London, 1853).

HENRY, MATTHEW, an eminent nonconformist divine, was born at a farmhouse in Flintshire, 18th October, 1662. His father left the Church of England in consequence of his refusal to subscribe to the Act of Uniformity. Matthew Henry received the principal part of his education under Mr. Doolittle of London. In 1685 he commenced the study of the law in Gray's Inn; but he soon relinquished this profession, and, after being ordained in 1687, settled at Chester as minister of a dissenting congregation. In 1712 he left Chester, and became the minister of another congregation at Hackney. He died on the 22nd of June, 1714.

The work by which Matthew Henry is principally known is his "Exposition of the Old and New Testaments," which originally appeared in five vols. folio in 1710, but which he did not live to complete beyond the Acts of the Apostles. He was also the author of various works, of which the principal are, "Inquiry into the Nature of Schism;" "Life of Philip Henry;" "Scripture Catechism;" "Communicants' Companion;" "Discourses against Vice and Profaneness;" "Method of Prayer;" and numerous sermons on separate subjects. His "Exposition" has enjoyed great popularity, and is even now occasionally reprinted. His miscellaneous works were republished in London in 1830.

HEPAT'IC (Gr. *hepar*, the liver), a term of very general use in anatomy and medicine as applied to the liver and its various functions and affections—as the hepatic duct and the hepatic artery, situated between the lobes of the liver; hepatic vein, the hepatic vessels; hepatic glands, which receive the veins within the liver; hepatic plexus, a kind of convoluta connected with the vena portæ and the hepatic vessels; hepatic glands, which receive the absorbents of the liver. The term is also frequently applied to mineralogical objects, from their resemblance to the dark blood-red colour of the liver; as hepatic pyrites, or hepatic sulphuret of iron, a variety of prismatic iron pyrites which on exposure to the weather receives a brown tarnish, and through oxidation becomes eventually decomposed.

HEPAT'IC CIN'NABAR is cinnabar mixed with idrialite (an impure bitumen), clay, and carbonaceous matter; it is compact and slaty, dark-red to iron black, and is the *mercure sulphur* of Hauy. Specific gravity, about ·7. It occurs with cinnabar.

HEPAT'ICÆ are minute moss-like plants, constituting with mosses the group Muscineæ. All the plants belonging to this group exhibit a well-defined alternation of generations. The spore gives rise to a vegetative structure, which is provided with sexual organs, and therefore called the sexual generation. From this first generation, as a result of fertilization, a structure entirely unlike it arises, still however united to it and nourished by it; this is the *sporogonium*. The sexual generation is the self supporting vegetative structure, commonly recognized as the scale-moss, liver-wort, &c., while the asexual generation or sporogonium is generally known as the "fruit." The vegetative structure is either a flat leaf-like body (thalloid), or it is moss-like in having a stem with leaves (foliose). The leaves, however, differ from those of most mosses in not having a mid-rib, and being cleft at the apex or rounded. The mode of growth is bilateral, the foliose forms even showing a tendency to a distinct upper and under surface. Hepaticæ are multiplied asexually by the thallus or stem dying off, and the new shoots becoming thus independent, or they are propagated by peculiar buds, called *gemmæ*. Single cells in the margin of a leaf may detach themselves; or cup-shaped bodies are formed on the upper side of the flat thallus, and from the base of these arise hair-like growths, the apical cells of which become large, and fall out as gemmæ. The sporogonium remains within the calyptra till the spores are ripe; it then usually breaks through, instead of carrying it up with it as in mosses, by the formation of a long stalk, and bursts in various modes to allow of the dispersion of the spores. Spiral threads called *elaters* are found mixed with the spores in most hepaticæ.

Hepaticæ are generally divided as follows:—(1) Anthocerotcæ, in which the sporogonium contains a central thread-like column (the columella), and its wall splits into two valves; (2) Monocleæ, in which there is no columella, and the wall splits by one line; (3) Ricciceæ, in which the sporogonium has no columella nor elaters, and the spores are set free by the decay of the cell-wall; (4) Marchantieæ (liver-worts), in which the sporangia are borne on the under side of stalked receptacles, and burst at the apex with teeth, or are four-lobed, or furnished with a lid; (5) Jungermannieæ (scale-mosses), in which the sporogonium splits into four equal valves.

HEPHAIS'TOS or **HEPHÆSTUS,** the god of fire in the Greek mythology, was the son of Zeus and Hera. Apollo was the god of sunlight and warmth and vivifying heat, Hephaistos, like the Latin Vulcan (Vulcanus), was the god of that fierce flame which the ancients believed raged everywhere below the earth, now and then finding terrible vent in Etna or Vesuvius, whence these mountains are called by the Italians volcanoes. These are the chimneys of the forge of Hephaistos, where, surrounded by the Cyclopes and other such swarthy helpmates, he fashions all kinds of wondrous metal-work.

Once, Homer relates, Hephaistos intervened in one of the perpetual quarrels between Zeus and Hera, and spake so warmly in defence of his mother that Zeus flung him out of Olympus. All day he fell, and in the evening crashed down in Lemnos, laming himself in the fall. At the end of the first book of the Iliad he alludes to this to stay a rising quarrel against his all-powerful father, and himself carries round the loving-cup to complete his work of pacification,—

> "A laughter never-left
> Shook all the blessed deities to see the lame so deft
> At that cup-service."—*Chapman's Homer.*

Later poets make his fall from Olympus the action of Hera, disgusted at his being born lame and diminutive; and make him plunge into the sea, where Thêtis received him in her arms and harboured him beneath Ocean for nine years. This time he spent in fashioning wondrous works, with which, aided by Dionysus, the god of wine, he gained readmittance among the Olympians. This form of the legend no doubt arose from the consideration of the position of volcanoes as known to the ancients, either rising from the bosom of the sea or by the verge of the shore. Every now and then, too, a fresh fire-mountain would arise from the deep, as has also happened in our own time. The lameness signifies, of course, the unsteady flicker of flame.

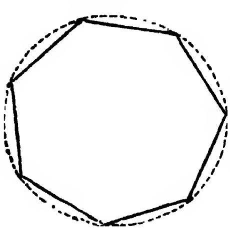
The work of Hephaistos was not limited to metals. He built the homes of all the gods in Olympus, he fashioned the thrones of Zeus and Hera, the shield of Achilles, &c. In the Iliad Charis (graceful loveliness) is his partner; Hesiod (who divides the Graces) allots him Aglaia, the youngest of the three; but the Odyssey and poets in general make him the husband of Aphrodite herself. In every case the union of skill with loveliness is aimed at. Also, as might be foreseen, mere skill is not sufficient to fix the affections of beauty; consequently Aphrodite is by no means constant. Her most constant admirer was Ares, god of battle—perennial union of love and war; and once Hêlios, the sun-god, rising high in heaven and discovering the pair from above, hastened to tell Hephaistos. He, having in readiness a wondrous net so fine as not to be felt, and so strong as not to be broken nor cut, quickly cast it

over the two as they lay. Then calling all the gods together he exposed them, regardless of his own mortification, to their universal laughter. Volcanic soil, when it has been disintegrated by the sun and rain, is most fruitful. Vesuvius and Etna are vast vineyards. Hephaistos consequently developed in later myth into a friend of Dionysus, god of the vine, and indeed in general as a god favourable to luxuriant growth. When Prometheus stole fire from the foot of the volcano Moschylos in Lemnos, and gave it to mortals, hitherto ignorant of its blessings, Hephaistos it was who nailed the transgressor alive to a rock in the Caucasus, by the permission and indeed by the command of Zeus, there perpetually to have his liver gnawed by an eagle.

HEPIAL'IDÆ is a family of moths distinguished by the obsolete proboscis, the wings being deflexed, long, and narrow, and by the very short antennæ and long bodies. Their larvæ live in the interior of vegetables, on which they feed, or in some instances they live in the ground, and feed upon the roots of plants. The principal genera contained in this family are Hepialus (GHOST-MOTH), Cossus (GOAT-MOTH), Macrogaster, and Zeuzera.

HEP'TACHORD (Gr. *hepta*, seven; and *chordai*, chords), a system of seven musical sounds, which, among the classical ancients, implied two conjunct tetrachords. The interval of the heptachord was equivalent to our seventh. In ancient poetry the word signified certain verses that were sung to the music of seven chords; that is, seven different tones or notes. In this sense the term was generally applied to the lyre when it had but seven strings.

HEP'TAGON, a plane figure of seven sides and seven angles. A regular heptagon is that of which all the sides are equal to one another and all the angles are equal to one another. No geometrical means of constructing this figure are known. The ordinary methods of Euclid fail in the attempt to inscribe it in a circle or to describe it about a circle. As it may be divided into seven triangles by lines meeting in its centre, and as the three angles of each of these triangles are equal to two right angles, the whole seven sets of angles are equal to fourteen right angles. But all the angles at the centre are manifestly equal to four right angles; the seven angles of the figure are therefore equal collectively to ten right angles (900°), and each angle of a regular heptagon is therefore 128·57°. Also, since a circle of suitable radius will pass through all the points of a regular heptagon, as in the figure, each side of the heptagon will subtend an arc one-seventh of the whole circumference in length. But as the whole circumference is equal to 360°, each side of the heptagon subtends an arc (or an angle) of a little over 51·428°, whence the heptagon may easily be experimentally constructed by measuring off arcs of this length along the circumference.



Regular Heptagon.

HEP'TARCHY (Gr. *hepta*, seven; *archê*, government), a rather absurd and now antiquated method of describing the state of things in Britain immediately succeeding the English Conquest. In the first place a *heptarchy* would correctly mean, not a division into seven governments, but a government by seven persons—a variation of an *oligarchy* (Gr. *oligoi*), or government by a few. But what is more fundamentally wrong about it is that there never were seven settled states in England in Old English times for long together. There were often more than seven principal states (always many more, if we reckon in the small kingdoms subject to larger ones), and sometimes less than seven, and it is not easy therefore to be sure which seven we are to select. The usual list would probably be Kent, Sussex, Wessex, Essex, Northumbria, East Anglia, and Mercia. But Kent and Sussex merged into Wessex, East Anglia into Mercia, and afterwards into Wessex, and Northumbria was made up of Bernicia and Deira, for a long time quite as much separate states as Sussex and Wessex. The true way of regarding this period is to take it as successively represented by the overlordships of Northumbria, of Mercia, and finally of Wessex; usually, indeed, under the more or less acknowledged sway of a bretwalda, and not as an assemblage of contemporary sovereign states. See ENGLAND (*History*).

HEPT'YL or **ŒN'ANTHYL,** the radical of heptylic or œnanthylic alcohol, having the formula C_7H_{15}. *Acetate of heptyl* ($C_9H_{18}O_2$) is a light oily liquid of agreeable odour, boiling at 180° C. (356° Fahr.) *Chloride of heptyl* ($C_7H_{15}Cl$) is a colourless liquid of agreeable odour, burning with a smoky, green flame, and boiling at 150° C. (302° Fahr.) *Hydrate of heptyl* ($C_7H_{16}O$) is heptylic or œnanthylic alcohol. It is found associated with amylic alcohol or fusel-oil in the brandy distilled from the marc of grapes, after the juice is expressed. It may also be obtained from the ricinoleic acid of castor-oil, or from enanthol ($C_7H_{14}O$) by the addition of hydrogen. It is an oily liquid, insoluble in water, and boiling at 173° C. (343° Fahr.) *Hydride of heptyl* (C_7H_{16}) is found in American petroleum, and in the oils obtained by the distillation of cannel coal at a low temperature. It is a mobile inflammable liquid, of pleasant odour, boiling at 98° C. (208° Fahr.)

HEP'TYLENE or **ŒNAN'THYLENE** (C_7H_{14}), a hydrocarbon found in the light oils obtained by the distillation of the Boghead mineral. It is a colourless oil with a peculiar odour of garlic, and boils at 95° C. (203° Fahr.) With chlorine, bromine, and iodine it forms chloride of heptylene ($C_7H_{14}Cl_2$) and chlorheptylene ($C_7H_{13}Cl$), bromide of heptylene ($C_7H_{14}Br_2$) and iodide of heptylene ($C_7H_{15}I$). Heptyl also combines with ethyl to form heptyl-ethylic ether or ethyl-œnanthylic ether ($C_9H_{20}O$).

HE'RA, the Queen of Heaven in the Greek mythology, to whom the Latin Juno was made to correspond, carried her chief attribute in her very name; for this is nothing else than *mistress* or *queen*. The Roman *herus* (master) and *hera* (mistress), and our own word for the young master, the future lord or squire, *heir* (he who inherits), preserve to us the Greek meaning. We trace it in Herakles, &c., and in fact it is one of those mysterious ARYAN ROOTS common to the speech of all that vast majority of the civilized human peoples of which we ourselves form one unit. Scholars represent it by the approximate crude form √GHAR, with the sense grasp, seize, hold, &c.

Hera, like Zeus, was a child of Kronos and Rhea. Swallowed at birth by Kronos, like all his other children, she, like them, was afterwards released, and was sheltered by Okeanos and Tethys, secretly uniting herself afterwards to her brother Zeus. This is Homer's account. But later poets could not throw away the opportunities of the marriage of all marriages, and according to them this was celebrated with the greatest splendour, all the gods giving presents, and Gæa (the Earth) for her gift presenting the tree of the golden apples, which was then planted at the foot of Atlas and watched by the HESPERIDES. Zeus is made by some poets to have married other divinities, as Themis, Metis, &c., before Hera; possibly an attempt to reconcile some idea of dignity and purity with the sensualities which many combined legends had seemed to attribute to the god. When one tribe held Zeus married to Metis alone, and another to Themis alone, and another to Demeter alone, while many more held him married to Hera alone, the manifest result of a combination of all would be the abominable and revolting infidelity which to superficial students degrades the fine Greek myths, or successive

marriages, as above suggested. But with Hera there is never any suggestion of the sort. She is always the truly dignified partner of the father of gods and men, unspotted by calumny. Level with Zeus by birth, she oftentimes refuses to yield to him; hence arise bitter quarrels, which, however, are never pushed so far as to lessen mutual respect. Homer relates (Iliad, i. 396) that once Zeus was so far enraged as to chain Hera by hands and feet, but that was for intended treason against himself. Pride, as becomes so exalted a deity, is the failing of Hera. Her favourite bird and emblem is the proud peacock, haughty and splendid, and she is attended by the glorious rainbow-goddess, Iris. Hera is the goddess of marriage and of childbirth in family life. By Zeus she was the mother of Hephaistos, Ares, and Hebe; and excluding Aphrodite, was the only married goddess in Olympus. Her supremacy over the other goddesses in rank is unquestioned. The stories about her, beyond those relating to her quarrels for supremacy, are exclusively confined to persecution of the fruits of her husband's infidelities, as in the legends of Io, of HERAKLES, of BACCHUS, &c. She also appears in the myth of JASON.

Clearly the origin of the worship of Hera lies in the personification of fruitfulness as coming from the sky. Zeus was the open sky, Hera the atmosphere. When they met in clouds upon Mount Ida fruitful rain fell upon the earth; when they quarrelled the thunder rolled and the lightning flashed, till the goddess yielded in angry tears, which poured down in a fierce deluge from the heavens. But soon the blue sky gladdened men once more, and Zeus and Hera were at peace again.

HERACLES, HERACLEIDÆ. See HERAKLES, HERAKLEIDÆ.

HERAC'LEUM, a genus of plants belonging to the order UMBELLIFERÆ. *Heracleum Sphondylium* (cow parsnip) is a native of Europe, and is found plentifully in the meadows and hedges of Great Britain. It affords wholesome and nourishing food for cattle, and is collected in Sussex for fattening hogs; hence it is sometimes called hog-weed. The seeds of the plant are diuretic and stomachic, and exhale a powerful odour. *Heracleum pubescens* is a native of Kurdistan in shady places, and of the Caucasus in alpine places. The young shoots are filled with a sweet aromatic juice, which is eaten by the natives of the Caucasus in a crude state. *Heracleum Pyrenaicum* is a native of the Eastern and Central Pyrenees, and of Italy. *Heracleum giganteum* is often cultivated on account of its noble-looking aspect, reaching a height of 10 or 12 feet. It is a native of Siberia.

This genus belongs to the tribe Peucedaneæ. The petals are often radiant. The fruit is compressed, with a wing-shaped margin; and the vittæ are solitary, shorter than the fruit. The plant is generally hairy. There are seventy species, mostly natives of the north temperate regions of the Old World; one is found in North America, and a few in the mountains of Eastern India and Abyssinia.

HERACLI'TUS or **HERACLEI'TUS** (Hêrakleitos) of Ephesus belongs to the school of the Ionian philosophy. He is said to have flourished about B.C. 500, and he died in the sixtieth year of his age. The title he assumed of "self-taught" refutes the claims of the various masters whom he is said to have had, and the distinguished position that he held in political life attests the wealth and lustre of his descent. The gloomy haughtiness and melancholy of his temperament led him to despise all human pursuits, and he expressed unqualified contempt as well for the political sagacity of his fellow-citizens as for the speculations of all other philosophers, as having mere learning and not wisdom for their object. He declined the supreme magistracy of Ephesus, which his fellow-citizens warmly pressed upon him, allowing, however, his brother to rule in his stead. Of his work "On Nature," the difficulty of understanding which obtained for him the surname of "the Obscure," many fragments are extant, and exhibit a broken and concise style, hinting rather than explaining his opinions.

The physical doctrines of Heraclitus formed no inconsiderable portion of the eclectical system of the later Stoics, and in times still more recent there is much in the theories of Schelling and Hegel that presents a striking though general resemblance thereto. The main positions of Heraclitus, so far as we can gather from the scanty fragments that remain, are that (1) although the senses frequently betray us they do so because they talk to ignorant ears—the senses tell truly, the ignorant mind perceives wrongly; and that (2) the mind when not nourished by the senses can have no true knowledge. Hegel claims to be his direct successor and expounder; for that astonishing paradox which is the flower and outcome of Hegelianism—"Being and not-being are the same"—is but a translation to modern language of the third doctrine of Heraclitus, (3) "All is and is not, for though in truth it does come into being, yet it forthwith ceases to be. All is motion, all is a *becoming*, not a being." The unstable Fire he took as the primordial element, if there were one—the true godlike, the *one* or *archê* in which all things participated. He saw the flux and reflux of things which produce phenomena by the union of contraries:—

> "All is changing, yet abiding,
> Death is ever giving life;
> Under weakness power is hiding,
> Love is in the midst of strife,
> In confusion order 's rife."
> —*A. J. Ellis.*

Or as another writer of our time puts the same ancient truth:—

> "Evil things not long are single;
> 'Tis the dark hours bring the light,
> Sightless atoms fashion sight,
> Discords still for concord mingle."—*Call.*

In contrast with this change, without which no earthly phenomena can exist, this great philosopher taught the permanency of the *one*, the supremely harmonious being in whom all contraries blended, the Eternal Immutable.

The teachings of Heraclitus so often took a melancholy turn as he enforced the mutability of things, that he was nicknamed the "Weeping Philosopher;" or perhaps this was but a contrast with his successor and avowed antithesis, the "Laughing Philosopher," Democritus. The fragments of Heraclitus have been collected from Plutarch, Stobæus, Clemens of Alexandria, and Sextus Empiricus, and explained by Schleiermacher in Wolf and Buttmann, and elsewhere.

HERAC'LIUS, one of the best of the Greek or Byzantine emperors (610–41), was born in 575, the son of the patrician Heraclius, governor of Africa under the much-hated Emperor Phocas. He assisted in dethroning the latter in 610, and was proclaimed emperor in his place. He applied himself to reform the lost discipline of the army; he renewed the truce with the Longobards of Italy, and held his own against the Avari, who had invaded Thrace and had advanced to the gates of Constantinople. These barbarians retired across the Danube in 619, loaded with prisoners and booty. The Persians meantime invaded Syria, devastated Jerusalem, and made an irruption into Egypt, in consequence of which the large supplies of corn which that country used to send to Constantinople were stopped, and the capital was afflicted by a severe famine. Another Persian army had advanced through Asia Minor to Chalcedon, but Heraclius induced the commander to withdraw, and sent ambassadors to treat of peace with Khosru, or Chosroës II., the Persian king, who spurned his offers, and summoned Heraclius and his subjects to abjure Christ and pay worship to the sun. Heraclius, roused by this insult, collected an army, and marched

against the Persians, whom he defeated in a succession of brilliant campaigns, and pursued them as far as the Tigris, in 622–27. The first year of the expedition of Heraclius against the Persians was the same in which Mohammed openly assumed the character of prophet and legislator, after his flight to Medina. Khosru was at last dethroned by his son Siroes, who concluded peace with Heraclius. At this time he was the most splendid and renowned prince in the world. But a sort of lethargy now seized him, and the latter years of the reign of this emperor were passed amid theological controversies. Heraclius supported the doctrine of the Monothelites, who taught that the human nature in Jesus Christ was entirely passive under the will of his divine nature. Pope John IV. (Italy being now quite independent of Constantinople), assembled a council at Rome in 640, which condemned the Monothelites. Meantime the Arabians, after the death of Mohammed, and under the caliphate of Abu Bekr, invaded Syria, Palestine, and Mesopotamia, and under the following caliphate of Omar they conquered Egypt and Cyrenaica. Heraclius was unable to oppose the torrent of Arabian courage and fanaticism; he sunk deeper into inactivity and sloth, and died of dropsy in February, 641, after a reign of thirty years. From that epoch the decided though gradual decline of the Eastern Empire may be dated.

HERAKLEID'Æ, the descendants of Herakles. According to tradition, after the death of Herakles, his children took refuge in Attica, in order to escape the persecution of Eurystheus, and they were hospitably received by Theseus. With the assistance of the Athenians they defeated Eurystheus, and after the battle they are said to have obtained possession of the whole of Peloponnesus; but they had not remained in the country long before a pestilence again drove them back to Attica. They attempted soon afterwards to march again into Peloponnesus, but were met at the Isthmus by an army consisting of Arcadians, Ionians, and Achæans. In a single battle with Echemos, king of Tegea, Hyllos, the eldest son of Herakles, was slain, and the Herakleidæ promised not to invade Peloponnesus for a hundred years. They retreated to Doris, where they obtained a considerable army to assist them in the recovery of their dominions. With the aid of an Ætolian chief named Oxylos, they crossed from Naupaktos to the southern side of the Corinthian Gulf eighty years after the Trojan War. The Dorians under the command of the Herakleid princes speedily conquered Peloponnesus, except Arcadia and Achæa. Elis on the gulf of Corinth was assigned to the Ætolians under Oxylos, the rest of the Peloponnesus was divided among the Dorians, and the old inhabitants were obliged to emigrate, or were reduced to the state of HELOTS.

Such is the traditional account of that important event in Grecian history, usually called "the return of the Herakleids," by which the Dorians obtained possession of the greater part of the Peloponnesus. Though the general tradition assigned the complete conquest of Peloponnesus to the sons of Aristomachus, the descendant of Herakles, it appears probable from other traditions that the greater part of the Peloponnesus was not reduced by the Dorians till long afterwards.

HERAKLEI'TOS. See HERACLITUS.

HE'RAKLES (*Hêraklês*), a demigod (ultimately a god) of the Greek mythology, is a source of the most splendid tales of force and courage which have been produced. We must not indeed consider Herakles as purely a Greek creation. His legends are far older. He is the vivification of the Chaldaic division of the heavens into the twelve signs of the zodiac. In fact, the Babylonian Isdubar or Gisdhubar is, as the Rev. A. H. Sayce shows ("Babylonian Literature," London, 1879), a solar hero, and his twelve labours were the originals of those of the Greek Herakles, who was himself the Tyrian sun-god, Melkarth:—

"The lion that Gisdhubar slew is the lion of Nemea; the winged bull that Anu made to revenge the slight of his daughter Istar is the bull of Crete; the tyrant Khumbaba slain by Gisdhubar in 'the land of the pine trees, the seat of the gods, the sanctuary of the spirits,' is the tyrant Geryon; the gems borne by the trees of the forest beyond 'the gateway of the sun' are the apples of the Hesperides; and the deadly sickness of Gisdhubar himself is but the fever caused by the poisonous tunic of Nessus."

In ways such as this it is becoming abundantly clear that the germs of much of the Greek pantheon and mythology, like the germs of Greek art, were primarily derived from Babylonia and Assyria through the hands of the Phœnicians or the nations of Asia Minor. The results of Assyrian research have thus proved themselves important not only to the biblical student, but to the Greek scholar as well.

The legends of Herakles undergo a most marked difference when we pass from Homer and the earlier poets to the later writers. Homer and the most ancient poets make him simply a man of gigantic force, son of Zeus by an amour with Alkmene, the promised wife of Amphitryon, and granddaughter of Perseus. Alkmene was deceived by Zeus coming to her in the form of Amphitryon, absent on a warlike expedition to avenge the death of her brother—a price at which she had set her hand. Grateful to the supposed victor, Alkmene yielded to Zeus; but was alarmed to find the true Amphitryon return the next day flushed with victory to claim his reward. Alkmene prudently kept her own counsel, and in due time gave birth to two boys, who were called Herakles and Iphikles. Meanwhile Zeus boasted to the gods that he was about to become the father of one who would rule the race of Perseus. Hera, stung by jealousy, induced him to swear that the boy born that day of the race of Perseus should rule as he had said. She at once hurried to exert her powers over childbirth, on the one hand holding back the birth of Herakles, on the other hastening by two months the birth of Eurystheus, son of Sthenelos, a Perseid. Zeus was enraged, but was powerless to violate his oath. Nevertheless, by his direction Hermes brought the baby Herakles to Olympus, when Hera, pleased with the child, and not knowing whose he was, put him to her breast, so that with the divine milk he drew in great draughts of strength, such as never else fell to the lot of mortal. Discovering the trick Hera determined to destroy him, and sent two serpents; but the child rose in his cradle and strangled them with his baby fists. He grew up killing lions, and alas sometimes men also, instructed by Amphitryon, a great charioteer, Autolykos, supreme in wrestling, Castor, in armed fighting, Eurytos in archery, at which he became most expert (Iliad, v. 395; Odyssey, viii. 224), and Linos in music. Linos he slew in a fit of boyish rage, which he bitterly repented, for his heart was as tender as it was brave. His fame was gall to Hera, who seized the first moment of his arriving at manhood to have his services demanded by Eurystheus, who, according to the decree of Zeus, had become King of the Perseids. Herakles, disdaining to be any man's servant, inquired at the oracle of Delphi. He was told that he must submit, but that after ten extraordinary feats of strength and prowess, covering twelve years, he should be freed. Herakles accordingly presented himself at Tiryns (*Mykenai*).

It is right here to say that much of this detail is not found in Homer or Hesiod, nor are the labours enumerated as twelve, though several are stated in the same form as that in which we usually have them. (Homer only gives the descent to Hades.) The "labours" begin at home, get further and further away, and finally plunge beneath the horizon in the descent to Hades. Their zodiacal character could not be stronger marked.

The Twelve Labours of Herakles were as follows. They

were performed at the bidding of Eurystheus, principally with no other arms than his bow and arrows and his mighty club, which he cut in the Nemean woods for his first adventure, nor was he otherwise protected than by the skin of the Nemean lion.

1. *The Nemean Lion.*—This had been sent by Hera to ravage the plains of Nemea. Club and bow and arrows were alike powerless to pierce its hide. When Herakles found this out he strangled the brute, and ever after wore its hide on his shoulders as an impenetrable cloak, or over his arm as a shield.

2. *The Lernæan Hydra*, another of Hera's gracious gifts, dwelt near Lernæ in Argos, in a swamp, infecting the whole country with its poisonous breath. It had nine heads and one contained its life, but as for the others when one head was smitten off two grew in its place. A gigantic crab also attacked him from behind. Herakles therefore ordered Iolaos, who accompanied him, to set fire to the wood hard by and supply him with burning brands. With these he seared each neck as he cut off a head, and finally reached the central head of the creature, which for fear it might be immortal he buried under a huge rock. He then dipped his arrows in the poisonous blood which lay in pools on the ground. Here we have manifestly the personification of the deadly vapours of a stagnant swamp.

3. *The Erymanthian Boar* raged in the wild mountains of Arcadia. After a long pursuit he was trapped by Herakles in a net and taken alive to Mycenæ by order of Eurystheus. While engaged in this long chase Herakles fell in with Pholos, one of the Centaurs, to whom Dionysus had sent a cask of wine, bidding him keep it till his good friend Herakles should pass that way. Other Centaurs smelling the wine crowded up, and in the confusion Herakles lost his temper and shot some with his poisoned arrows. One of these was Cheiron his old friend and the master of Achilles. Pholos stooping to draw out the arrow dropped it point downwards on his foot, so that he too died.

4. *The Arcadian Stag*, or Keryneian or Mænalian Stag, with golden antlers and brazen feet, turned wild and devoted to Artemis by the nymph Taygetes. Herakles chased it a whole year till it returned to the place where he had first seen it. He wounded it and would have killed it, had not Artemis appeared and forbidden him to do so.

5. *The Stymphalian Birds* were also in the wild ravines of Arcadia. Probably, like the Harpies, they were the personification of the sudden mountain storms. They were figured as birds with brazen beaks and claws, using their feathers as arrows and feeding on human flesh. Herakles rang a great bell or clanging rattle, which made them leave their nests and approach in curiosity. His arrows killed the most and drove the rest far away. The Argonauts ran against the remnant and were extremely annoyed by their sharp biting feathers, which they shot out in showers. Evidently we have here depicted a severe snowstorm with a piercing wind.

6. *The Augean Stables.*—Augeas, son of Helios, and king of Elis, had 3000 oxen. The stables had not been cleansed for thirty years. This task Herakles accomplished alone and in one day, as the bargain ran, by leading the rivers Alpheus and Peneus from their courses, and letting them through the stables. Augeas had agreed to give a tenth of his herd for the service, but when he learned that it was done by command of Eurystheus he refused to pay. On the other hand Eurystheus claimed not to count this as one of the twelve labours, seeing that it was done for reward. He also disputed the Hydra labour, since Iolaos had helped in it.

7. *The Cretan Bull.*—Minos, king of Crete, had refused to sacrifice a certain bull because of its beauty, and Poseidon sent it mad, and endued Queen Pasiphaê with a fearful passion for it to punish him. Herakles captured the bull, and made it swim across to Greece, carrying him on its back. He then let it loose, and eventually Theseus captured it at Marathon long afterwards.

8. *The Thracian Mares of Diomedes.*—Diomedes, son of Ares, was king of Thrace, and fed his mares with human flesh. Herakles captured them as he was bidden, but was attacked by the Thracians. He repulsed them, giving the mares to Abderos to hold—a dreadful pledge, for the creatures devoured him. (Herakles built the town of Abdera in his honour.) Turning on Diomedes the hero slew him in wrath, and gave his body to the mares. This had the effect of taming them, and he brought them easily home.

9. *The Girdle of Hippolyta.*—This famous queen of the Amazons, a warlike race of women, had a girdle given her by Ares, and the daughter of Eurystheus desired to possess it. In this enterprise Herakles was assisted by many heroes, all of whom the queen received graciously. She was about to give Herakles her girdle when Hera interposed and turned Hippolyta's mind. A contest now ensued in which the queen was slain and her girdle taken by Herakles.

10. *The Oxen of Geryones.*—Geryones was a triple man, three heads, three bodies, and three pairs of limbs, all joined in one whole. He lived in the island of Erytheia (Balearic Isles), and kept his oxen close under the guard of the giant Eurytion and his double-headed dog Orthros. Herakles borrowed the vessel in which Helios (the sun-god) sailed nightly to the west, and passed the Straits of Gibraltar, where he erected two pillars at the entrance into the wide ocean. Okeanos, indignant, raised a storm, and Herakles had to shoot at him with his arrows till he gave way. He successively slew dog and giant, and began driving the oxen when Geryon appeared. A long fight was ended by the fatal arrows of the hero. He had many subsidiary adventures while bringing the oxen along the weary land journey home after crossing in the vessel of Helios and returning it to him. The robber Cacus, when he passed through Italy, dragged some of the oxen into a cave by their tails, so that their footprints did not betray them; but he forgot to muzzle them, and they lowed to their companions, so that Herakles discovered and avenged the theft. One of the bulls swam across to Sicily also, and Herakles swam after it on another bull and brought both back, and so on all the way. Finally, a gadfly sent by Hera did more damage than all the other trials; and he only reached Greece by way of the shores of the Adriatic with a comparative remnant of the herd he started with.

Eight years had now passed and ten labours been performed; but Eurystheus disputed two of them, and successfully claimed two more in their place. These were—

11. *The Golden Apples of the Hesperides.*—These grew on the miraculous tree given to Hera on her marriage by Gæa. The three daughters of the evening star Hesperus—Ægle, Hesperia, and Arethusa—watched the tree on Mount Atlas in the country of the Hyperboreans. No one knew where this was, and Herakles wandered long. Certain nymphs of the Rhone referred him to Nereus, and although the god tried all the transformations for which he was famous, he could not escape from the grasp of Herakles till he had parted with the secret. Herakles accordingly proceeded to Libya, encountering on the way a son of Gæa, Antæus, whom he wrestled with in vain, since each time Antæus touched his mother (Earth) she renewed his strength. He soon was strangled, however, when Herakles crushed his life out in the air. Lying down tired after this exploit he fell asleep, and the tiny folk called Pigmies surrounded him (as in our own literature the Liliputians did Gulliver). Waking up under the stings of their invisible arrows, he wrapped them all up in his lion's skin and killed them. Nearing Egypt he was overpowered, bound, and offered for sacrifice to Isis; but bursting his bonds he effectually turned the tables by sacrificing the king and his court.

He journeyed on through Scythia, India, &c., meeting with all kinds of adventures, till he came to the region of the Hyperboreans. Making friends with the Titan Atlas, who bore the whole world on his shoulders, Herakles took his load while Atlas picked the apples. The Titan, returning, proposed to take them to Eurystheus himself, delighted once more at having free shoulders. Herakles appeared to consent, but made the condition that Atlas should raise the world a little that he might pad his shoulders. When the Titan had once more taken his burden, however, Herakles made off with his booty, regardless of his cries. Athena, who received the apples, restored them to their place.

12. *Cerberus and Hades.*—This was the last and worst labour. Herakles descended into Hades by a chasm in the earth, and the Shades were lost in wonder and fright when he appeared among them. He found Theseus and Peirithoüs fixed to a rock, and was able by his great strength to free the first and convey him to the upper air again. Cerberus, the three-headed dog who guarded the entrance, Pluto permitted him to bear up to earth as he had engaged to do, if he could accomplish it without arms of any kind. This too was done, and what perhaps was a worse toil, the monster was carried back again.

These labours over and his servitude ended Herakles went to Thebes. In a fit of madness he slew his friend Iphitos, and was ordered by the oracle at Delphi to serve for wages for three years, and pay them to the father of Iphitos. The oracle was not delivered, however, till Herakles had attacked the reluctant Apollo, and wrestled with him till parted by the lightning of Zeus. Hereupon Herakles took service under Omphale, queen of Lydia; and the poets and sculptors represent him as dressed like a woman and engaged with the labours of the loom and distaff, while Omphale wears the club and lion's skin. Later he joined the ARGONAUTS in their quest, MELEAGROS in the hunt of the Calydonian boar, took Troy from Laomedon, helped the gods in their war against the giants, which could only be successful with mortal help, &c. He fought Acheloös for Dejanira, and won her for his wife. An accidental homicide drove him into exile, and as they crossed a stream his wife, whom the Centaur Nessos was carrying, was insulted by him. Herakles at once shot him. As Nessos lay dying he begged Dejanira to bathe a garment in his blood, which he assured her would effectually bring back her husband's love to her if it should ever stray. In the course of numerous other adventures he conquered Eurytos, who long before had refused him his daughter Iole in marriage. Iole (sister of his lost friend Iphitos) now fell into the hands of Herakles, and Dejanira, alarmed at her husband's evident respect for the princess, gave him the robe of Nessos to put on. The blood of Nessos, as the Centaur well knew, was poisoned by the arrow of Herakles himself, and as soon as it touched the hero's skin, so far from acting as a love philter, it clung to him inseparably and burned him with inconceivable torture. He tore away large pieces of flesh in agony. Dejanira hanged herself. The hero, commanding his son Hyllos to marry Iole, built a funeral pile, which he ascended and lit himself. Thunders from heaven proclaimed the approval of the gods. He was caught up to Olympus, and even Hera herself welcomed him with honour and gave him her daughter Hebe (eternal youth) to wife.

There are countless other myths about Herakles, perhaps the most beautiful being that of Alkestis (Alcestis). He figures in painting and sculpture, in poetry and the drama, as the grand embodiment of strength and courage among the wondrous people whom we call the ancients; and from them he and his myths have passed onwards to become part and parcel of our modern daily life. Few weeks pass in which the Hydra, or Cerberus, or the Augean stable, &c., are not used in our controversies as weapons wherewith we belabour one another, as if the hero's club itself were ours.

HER'ALD, an officer whose duty, during the middle ages, was to carry both challenges and peaceful messages from one prince or nobleman to another, to proclaim peace or war, to lay out the lists in jousts or tournaments, to be the witness of all combats, and to record in writing the names of those who behaved most valiantly, to number the dead after battle, and specially to supervise all matters connected with the bearing of coat-armour, the marshalling of processions, and other state ceremonies. His functions were something like those of the Greek *kerux* and the Roman *fecialis;* but the origin of the name is much disputed, and the actual date of the institution uncertain. The earliest mention of a herald in England is in Edward III.'s reign; but there is little doubt that the office existed as early at least as the dawn of hereditary coat-armour. There are three orders or grades of heralds, namely, kings of (or at) arms, heralds, and pursuivants. They were anciently created with much ceremony, but are now simply appointed by the earl marshal in England and by the Lyon king-of-arms in Scotland.

The present number in England is thirteen. Three kings-of-arms—Garter, Clarencieux, and Norroy; six heralds—Somerset, Chester, Windsor, Richmond, Lancaster, and York; and four pursuivants—Rouge Dragon, Portcullis, Blue Mantle, and Rouge Croix. In Scotland there is one king-at-arms, named Lyon; six heralds—Snowdoun, Albany, Ross, Rothesay, Marchmont, and Hay; and five pursuivants—Unicorn, Carrick, Kintyre, Ormond, and Bute. Ireland has one king-at-arms, Ulster; two heralds, Cork and Dublin; and two pursuivants, Athlone and St. Patrick. To these regular officers are sometimes added, by command of the king to the earl marshal, a herald or pursuivant extraordinary.

HER'ALDRY, the art of arranging and explaining in proper terms all that appertains to the bearing of coats of arms, badges, and other hereditary or assumed marks of honour; also the art of marshalling processions and conducting the ceremonies of coronations, instalments, creations of peers, funerals, marriages, and all other public solemnities. Technically stated it is the "art of blazoning and assigning coat-armour." Without going to the lengths of the enthusiastic Gwillim, who professes his ability to blazon the arms of Osiris, Anubis, and Herakles from the indication of Diodorus Siculus, most men will admit that a considerable antiquity for heraldry (though not for hereditary coats of arms) can be claimed, and this on the score of the Greek poets, setting aside Homer and Hesiod, whose heroes' shields seem rather decorated for splendour's sake than with any definite heraldic meaning. We find in the great tragedians' accounts of early heroes careful descriptions of the devices borne on their shields, and it seems no unfair deduction to consider these devices as handed down by tradition. Æschylus gives the whole of the arms of the "Seven against Thebes" (ver. 434), of which princes Capaneus bore on his shield the figure of a naked man holding a lighted torch, and the motto *Prêsô polin* (I will burn the city), and so on for the rest. The origin of the motto is here shown to be a war-cry. Euripides assigns somewhat different bearings to the heroes; for instance, it is with him Tydeus and not Capaneus who bears the torch-bearer, but the principle is the same. To the young hero Amphiaraos, who had not as yet performed any feats of arms, is by both poets given a blank shield; and Virgil, in a like case of a young hero (Æneid, ix. 548), figures him as *parmâ inglorius albâ* (inglorious, with a blank shield).

Nor was the *crest* unknown to antiquity. In Homer we read of the nodding crests of the heroes, at once a terrible ornament and a defence against swordcuts. But in Virgil this crest is fastened in front with forms of animals, &c.; thus Turnus bears on his helmet a chimæra as crest. In Silius Italicus we see Corvinus with a crow for his crest, and in his particular case it was a hereditary

crest. Turnus in Virgil's description so far wears hereditary arms as that the device on his shield relates to his ancestress Io (Æneid, vii. 789), and so in many other cases (Æneid, vii. 657; x. 187, &c.) Though not apparently a very general custom, yet it must have continued in a certain measure through the period of ancient history, for Caligula, one of the first Roman emperors, issued a decree in one of his mad freaks to deprive the Torquati of their chain (*torques*), the Cincinnati of their hair (*cincinni*, curls), and so on, plainly meaning the hereditary devices adopted by those families, in fact the decree calls them *familiarum insignia.*

But another species of heraldic ornament of the Latins was not limited to a few families. This was the crowns of honour conferred upon men for special services to the state. Thus the conqueror in the East wore the eastern crown (Plate I. fig. 1), he who won a great victory received a triumphal crown of laurel (fig. 2), and as Cæsar, on account of his many victories (and perhaps to conceal his baldness), continually wore this crown as imperator, it came to be the imperial crown. Princes wore the circlet (fig. 3). They who raised the siege of a besieged town wore the obsidional crown, made of grass plucked from the ramparts (fig. 4). The oak-leaved civic crown (fig. 5) was decreed to him who saved the life a citizen. The vallary crown (fig. 6) was bestowed on the first soldier to scale the earthworks of the enemy, the mural crown (fig. 7) to him who first mounted the wall, and the naval crown (fig. 8) decorated for similar services at sea. The celestial crown (fig. 9) is found on statues and coins of deceased emperors, who, according to the Roman custom, were adored as deities after their death; and this notion of so varying the heraldic devices as to show that their bearer is dead survives in our hatchments and funeral escutcheons.

The origin of heraldry, in the first and most commonly understood sense, has been attributed, by the general consent of the best writers on the subject, to the necessity for distinguishing by some outward sign, amidst the confusion of battle, the principal leaders during the expedition for the recovery of the Holy Land. But nothing is absolutely known concerning it beyond the fact that the middle of the twelfth century is the earliest period to which the bearing of heraldic devices properly so called can be traced, and the commencement of the thirteenth the time about which they became hereditary.

The earliest roll of arms of which we have any notice is of the reign of Henry III., and the reign of Edward I. presents us with the earliest heraldic document extant. The famous roll of Caerlaverock, a poem in Old Norman French, rehearses the names and armorial ensigns of all the barons, knights, &c., who attended Edward I. at the siege of Caerlaverock Castle in 1300. Heraldry is therein first presented to us as a complete system. The principal rules and terms of the art were then in existence, and from about that time the terms are continually found in the fabliaux and romances of France and England.

The oldest writer on heraldry whose work has descended to us is Nicholas Upton, whose treatise, "De Militari Officio," was composed in the reign of Henry V., and translated in that of his successor by the Abbess Dame Juliana Berners, in the "Boke of St. Albans" (about 1475). In the reign of Richard III. the English heralds were incorporated and the college of arms founded, and in the following century a swarm of writers arose, both in France and England, many of whom wasted much learning and research in the most absurd and idle controversies.

On the decline of chivalry the study of heraldry became gradually neglected, and the art which had formed for centuries a portion of the education of princes, and occupied the attention of some of. the most learned men in Europe, was abandoned to the coach-painter and the undertaker, while kings-of-arms and pursuivants were looked upon as mere appendages of state pageantry, their office ridiculed, and their authority defied.

That the pedantry of such writers as Morgan, Ferne, Mackenzie, and others, contributed to these results, there can be little doubt. A taste for the critical study of antiquities generally is now, however, reviving throughout Europe, and the use of heraldry as a key to history and biography is daily becoming more acknowledged. The rules of heraldry as now practised at the college of arms vary in some points from those observed in France and Germany.

According to the received authorities there are ten classes of arms.

1. Arms of *dominion*, being those which princes bear as annexed to the territories they govern.

2. Of *pretension*, those borne by princes who are not in possession of the dominions to which such arms belong, but who claim or pretend to have a right to such possession; as, for instance, the kings of England from Edward III. to George III. quartered the arms of France.

3. Arms of *community*, being those of bishoprics, cities, universities, and other bodies corporate.

4. Of *assumption*, such as are assumed by a man of his proper right without grant.

5. Arms of *patronage*, such as governors of provinces, &c., add to their family arms, as a token of their jurisdiction.

6. Arms of *succession*, borne by those who inherit estates, &c.

7. Arms of *alliance*, such as the issue of heiresses take up to show their maternal descent.

8. Arms of *adoption*, borne by a stranger in blood inheriting estates on condition of assuming the testator's name and arms.

9. Arms of *concession*, augmentations granted by the prince of part of his own ensigns or regalia to such persons as he pleases to honour therewith.

10. Arms *paternal* and *hereditary*, such as are transmitted from the first possessor to his son, grandson, great-grandson, &c.; thereby forming complete and perfect nobility—the son being a gentleman of second coat-armour, the grandson a gentleman of blood, and the great-grandson a gentleman of ancestry. As a specimen of the way in which heraldry penetrated to the heart of men in the middle ages, so that arms of some kind were necessary to all who claimed respect, the following quaint extract may serve:—"Cain and all his offspring became *churls* both by the curse of God and his own father. Seth was made a *gentleman* through his father and mother's blessing, from whose loins issued Noah, a *gentleman* by kind and lineage. Of Noah's sons Chem (Ham) became a *churl* by his father's curse, on account of his gross barbarism towards his father. Japhet and Shem Noah made *gentlemen*. From the offspring of gentlemanly Japhet came Abraham, Moyses (Moses), and the Prophets, and also the King of the right line of Mary, of whom that only absolute *gentleman* Jesus was borne; perfite God and perfite man according to his manhood, King of the land of Juda and the Jewes, and *gentleman* by his Mother Mary, princess of Coate Armour" ("Boke of St. Albans").

These several sorts of arms are displayed on shields or escutcheons and on banners, the ground of either being called the field, and the figures borne upon it the ordinaries and charges.

Blazonry is the art of properly expressing a coat of arms. The word blazon is simply the German *blasen*, the trumpet-blast with which the mediæval heralds prefaced the recital of the lordships of their princes. The word coat is derived from the surcoat or covering of the armour, upon which the arms were emblazoned; but as they were also repeated upon the shield, this latter is taken as a more convenient form whereon to display them. Fig. 1, Plate II., is the true Norman shield; the other forms are

modern, adopted at first either from love of variety or from the want of room to display certain complicated coats of arms, and grown so common by the sixteenth century as to be used ever since almost to the exclusion of the correcter form.

The shield has to be held before the body, consequently the *dexter* side is to the left as we look at it from the front or as it is pictured upon the page, and the *sinister* side is to the right. Every shield has certain honour-points, which are (Plate II. fig. 1) A, *dexter chief* (Fr. *chef*, head); B, *middle chief;* C, *sinister chief;* D, *honour point*, so called because it is level with the breast of the warrior; E, *fess point*, bisecting the fess or horizontal division of the shield, symbolizing the scarf (Lat. *fascia*) worn round the waist or middle of the surcoat; F, *nombril point*, another allusion to the surcoat; G, *dexter base;* H, *middle base;* I, *sinister base*. The field may be of metal, colour, or fur, expressed in illuminated designs by the proper colours, and in engravings by the system invented in the seventeenth century by Silvestro di Santa Petra. Fig. 2 accordingly represents the *metals*—*or* (gold) on the dexter side, to the left; *argent* (silver) on the sinister side, to the right, the terms dexter and sinister being reversed in heraldry, as above explained. *Or* is represented in painting by actual gold, or by yellow shaded when necessary with burnt sienna; *argent* by actual silver, or by white shaded when necessary with black. Fig. 3 represents the colours: (1) *gules* (vermilion red); (2) *azure* (sky blue); (3) *sable* (black); (4) *vert* (green); (5) *purpure* (royal purple); (6) *murray* (dark red); and (7) *tawny* (dull orange). The figures show clearly the manner in which these seven heraldic colours and two metals are expressed by the dots and lines of engraving. It may be added that the seven colours were held to be connected with the planets and the metals, the days of the week, the months of the year, &c., as well as with the varying ages of man, his temper, his fortunes, &c., in a manner now hardly conceivable. The colours *murray* and *tawny* were not in much request, *or* and *argent* therefore supplied their place in these tables; and the following must serve as a small specimen of the interconnection alluded to, so often a matter of reference in our earlier dramatists and writers that it cannot be entirely neglected.

1. *Or*, yellow, topaz, Sun, July, Sunday, &c.
2. *Argent*, white, pearl, Moon, June, Monday, &c.
3. *Gules*, red, ruby, Mars, March to Oct., Tuesday, &c.
4. *Azure*, blue, sapphire, Jupiter, April to September, Thursday, &c.
5. *Vert*, green, emerald, Venus, May to Aug., Friday, &c.
6. *Purpure*, purple, amethyst, Mercury, February to November, Wednesday, &c.
7. *Sable*, black, diamond, Saturn, June to December, Saturday, &c.

The third description of heraldic field is the *furs*, which are shown in figs. 4 and 5, Plate II. (1) *Ermine* (white, spotted with black tails); (2) *ermines* (the same, but with white on black); (3) *pean* (ermines, but with gold on black); (4) *erminois* (ermine, but with black on gold); (5) *vair* (blazoned, white and blue, unless otherwise stated); (6) *vairy tassy* (Fr. *vairé* and *tasse*, a cup); (7) *erminites* (ermine, but the tails black and red mixed); (8) *vairy* (Fr. *varié*), a name given to a furry field of various colours, the shape of the designs being that of *vair*.

After the field we come to the *charge*, that is, the object delineated upon the field; and here we are face to face with a variety quite infinite. One general rule is laid down—that metal must not be blazoned on metal, colour upon colour, nor fur upon fur. Thus *azure*, a swan *gules* (blue field, red swan) would be false blazonry; *argent*, a swan *gules* would be correct in form. The only exception is to objects depicted in their proper colours. Thus *sable*, a heart proper, is allowable. Charges are *counterchanged* when the field is of two kinds and the change varies conversely to the field. The charge is always blazoned in high relief upon the field, with the light falling from the dexter chief; and in blazoning, the field is always mentioned first and the charge afterwards, the fewest possible words being used.

The simplest description of heraldic charges are the *ordinaries*. These are portions of the escutcheon comprised within straight or other lines. Ordinaries have very frequently straight boundaries, but other varieties of boundaries are in use, and these are shown in Plate II. (engrailed, wavy, indented, &c.) If the ordinary lie in a curved line across the field it is called *arrondy* or *archy*.

The simplest ordinary is the *pale* (Beauvais, Plate II.), and its diminutive is the *pallet*. In the arms of Mechlin we see *or*, three pallets wavy, *gules*. A pale is sometimes supported by *endorses* or *vergets*, as in Bellasius, *argent*, a pale engrailed endorsed, *sable*. If the coat is bisected by a vertical line (as Plate II. fig. 2), it is said to be *party per pale;* if by a horizontal line, it is *party per fess*. The diminutives of the fess are the *bar*, as Harcourt (Plate II.), *gules*, two bars, *or;* a half bar is the *closet;* a fourth of the bar is the *barrulet*. If the field is divided horizontally into several equal parts which are tinctured alternately, this is called *barry*, as Hungary (Plate II.), barry of eight, *argent* and *gules*. Fribourg, which follows (Plate III.), shows a simple charge per fess, *sable* and *argent*. A fess taken high in the shield is a *chief*, as in Friars of St. Augustine; *party per chief* is shown in Camoys.

Charges lying vertically are *palewise*; thus Bristol (Plate III. second row), *sable*, three crowns palewise, *or*. Corresponding with palewise we have *fesswise*, to express charges lying horizontally, as Oxford, *azure*, a book expanded fesswise, *argent*, having seven labels on the dexter side, bearing seals *or*, and inscribed "Dominus Illuminatio mea" between three crowns of the third. Such a coat as that of the Girdlers' Company (Plate III.) is an example of another mode of dividing the escutcheon; this would be blazoned paly of three, *azure* and *or*, party per fess counterchanged, three gridirons of the second. If a shield is parted both per fess and per pale it is said to be divided *quarterly*, as in figs. 4 and 5 (Plate II.) Arms may bear a quarter, as Stanton (Plate III.), vair, *argent* and *sable*, a quarter, *gules;* when the bearings of several families are marshalled in the same escutcheon by vertical and horizontal lines they are said to be *quartered*. Croatia gives an example of the charge called *checky*. Enough examples in full have now been given to show the manner of blazoning, and therefore succeeding remarks may be confined to the special point to be noted.

The *cross* (the so-called St. George's Cross) is shown in the arms of Italy, and the cross *aiguiscy* (Fr. aiguisé) in Dukenfield, Baronet (Plate III.) This escutcheon demands notice on another count. The open unbarred helmet above it is borne by baronets as being of knightly rank, and in addition to this they bear the badge of Ulster, shown in Dukenfield—viz. a small escutcheon at the dexter chief, or sometimes at the middle chief or the fess point, with a sinister hand erect, *apaumy* (open), *gules*. This is the popularly-known *red hand* of the baronets. Its name "of Ulster" is because the first baronets were created by James I. for the purpose of recovering that revolted colony.

Returning to the crosses, their varieties are very numerous. A few are given in Plate III. Dunkeld (old bishopric) shows a *cross calvary* on three *grieces* (steps) between two passion-nails; Lithuania, a *patriarchal cross;* Hersfeld, a *cross lorrain;* Taddington, a *cross crosslet;* Bulwark, a *cross cramponny;* Doubler, a *cross double-parted;* Navarre, a *cross pommy* (Fr. pommé). Toulouse, a *cross clechy pommetty* (*clechy* describing the curved edges of the members of the cross, *pommetty*, a diminutive of *pommy*);

Winwood, a *cross botonny*, a variety of *pommy;* Bolton, a *cross flory*; Wandley, a *cross paty convex;* Honstein, a *cross paty concave;* if the cross paty cover the shield it is called *firmy*, as in Constance; Edmund Ironside shows a *cross paty fitchy*, with a spike beneath, as if to be thrust into the earth, this special variety of "paty fitchy" being denominated *fitched in the foot* (Howard, a few shields later on, shows the ordinary *paty fitchy* in its six crosslets); Wyntworth, a *crosslet degraded* (*i.e.* with steps towards the circumference); Lichfield, four small *crosses paty* and a large *cross potent*, *i.e.* crutch-shaped at the ends. The cross of Malta, used in the insignia of the Bath, &c., is a cross paty with double points to the ends. But there is no end to the varieties of heraldic crosses. As Dame Juliana Berners of St. Albans justly says, running into capital letters to mark her earnestness, "How many crossis be borne in armys? To the wich question under a certein nowmbour I dare not answere, for crossis INNUMERABULL are borne now daily."

The *bend* (Howard, Plate III.) runs from dexter chief to sinister base, the width of a pale throughout its length; the *bendlet* is shown in Byron; and small bendlets supporting a bend are *cotises*, as in Fortescue; blazoned, *azure*, a bend ingrailed cotised, *or*. The whole field may be *bendy*, as in Angoulême; or *party per bend*, as in Boyle; *paly bendy*, as in Bavaria; or *barry bendy*, as in Husberg.

The *gyron* is a triangular space inclosed by two lines running bendwise and fesswise: Campbell shows a whole field, *gyronny* of eight.

The *bend sinister* runs from sinister chief to dexter base. The bend (or *bar*) sinister has a special meaning, as appears in the arms of Grafton, the ancestor of which family was an illegitimate son of Charles II., which accounts also for the arms of England lying below. This expression is more generally used to denote mere position, as in Winchester (bishopric, Plate IV.), where we have two keys "endorsed" (back to back) in bend, a sword in bend sinister. The two bends in combination are called *saltire* (commonly denominated St. Andrew's Cross), as Bath and Wells, and charges lying *saltirewise* are so described; as the swords of the bishopric of London. If the field is cut up into diamonds by many lines drawn saltirewise, it is called *lozengy*, as in Monaco (same Plate); and Graffen Egg gives an example of a *grand lozenge* which touches all sides of the shield. A voided (hollow) lozenge is called a *mascle* (mesh of a net); Vernon shows a *fret*, which is a mascle interlaced by a saltire, and De Montier Aullier a combination of frets which gives the bearing called *fretty*. So also charges crossing one another, as Troutbeck, are said to be *fretted*. When the lozenge is elongated it becomes a *fusil* (Salley), and a bearing composed of fusils is called *fusilly* (Magdalen College).

A *chevron* is properly the lower half of a saltire. It is the French for a pair of rafters, which indeed it resembles. Gwillim cannot be too severe upon those who depress the points of the chevron below the middle chief; but as a rule the heraldic heresy of rising only to the honour-point is now followed. A chevron may be turned, such as Tournay, a *chevron tourny sinister;* or chevrons may be *interlaced*, as Fitzhugh; or *fracted*, as Winterfall; or *removed*, as Shakstaff; and the diminutive of the chevron is the *chevronel*, as in Clare. The whole escutcheon, as Aston, may be *party per chevron;* if covered with chevrons, *chevronny*. Charges also may be *in chevron*, as Pearson (Plate IV.)

The *pall*, so called from its resemblance to the archiepiscopal pallium, is formed by the meeting of both bends and a pale, as Pauling (Plate IV.)

The *pile* is of course the point of a javelin or *pilum*. It is shown simply in Chandos, *per traverse* in Rathlone, and *per inverse* in Meinstorff (Plate IV.) This is the last of the great ordinaries and their derivatives.

A few other charges of similar nature remain to be noticed. The chief is the *bordure;* as in Magdeburg, party per fess, *vert* and *argent*, each *imbordured*. Its diminutive is the *tressure*, usually double, as in Stuart, sometimes triple; usually also *flory* (with fleurs-de-lis), and frequently, as in Stuart, *flory counterflory* (*or*, a fess checky, *argent* and *azure*, within a double tressure flory counterflory, *gules*), that is, with the flowers alternately opposed. The *tressure flory counterflory*, which surrounds the lion of Scotland on our coins (*or*, a lion rampant within a double tressure flory counterflory, *gules*), was added by Charlemagne on the occasion of his league with Achaius, king of Scotland, to signify that the lilies of France should always protect the lion of Scotland. True or not, the story was borne out for many long centuries by facts, often to England's bitter sorrow. Another charge is the *inescutcheon*, always placed upon the fess point, and when voided, as in Balliol College, called an *orle* (Plate IV.); and several separate charges disposed in such a figure are said to be *in orle*.

Other charges are called *common charges*, and of these were are three which partake somewhat of the nature of ordinaries; they are *roundels*, shown in Abtot, and *guttes*, in St. Francis (Plate IV.), and *billets*, small parallelograms set up on end. The roundel is a circular disc, supposed to represent the dint of a blow upon the shield. Foreign heralds call all roundels *tourteaux*, but English heralds call those of each tincture by a different name. In like manner *guttes* (drops, presumably in their origin drops of blood) have peculiar names, according to their different tinctures. These are as follows:—

Roundels: gold, called *bezants* (a coin); white, *plates* (Span. for silver); red, *tourteaux* (a cake); blue, *hurts* (a flower); green, *pommes* (an apple); black, *pellets;* purple, *golpes;* wavy argent and azure, *fountains*. Thus a roundel *or* is blazoned not so, but simply a *bezant*. Such a bearing as that on the escutcheon of Abtot (Plate IV.) is blazoned "per pale *or* and *gules*, three roundels counterchanged," however. A field covered with roundels is called *bezanty*, *platy*, *semy of tourteaux*, &c., according to the tincture of the roundels.

Guttes: gold, *gutty d'or;* white, *d'eau;* red, *de sang;* blue, *de larmes;* black, *de poix;* green, *d'huile d'olive*. The arms of the penitents of St. Francis (Plate IV.) are *sable* gutty d'eau, in chief a dove descending, *argent*. A field covered with billets is *billety*, as in the escutcheon of the Netherlands.

Common charges are divided into animate and inanimate. If animate, they move towards or face the dexter side (*i.e.* to the left), unless otherwise stated; if they face the sinister side they are *contourny*. Parts of bodies may be used, as the famous three armed legs of the Isle of Man (Plate IV.) Beasts are said to be *passant* when walking, *rampant* when rearing, *saliant* when springing forward, *sejant* when sitting, *statant* when standing, *current* when running, *couchant* when lying, *dormant* when sleeping, *nascent* when rising from the midst of any ordinary, *issuant* when rising from the top or bottom. The lion *sejant gardant* of the crown of Scotland is called *assis;* a deer *statant gardant* is said to be *at gaze*. Two opposed rampant beasts are *combatant*, or if back to back *adossy*. Two beasts crossing one another are *countertripping* (as Cottingham, Plate IV.), *counterpassing*, &c. Lions are always *armed* (claws) and *langued* (tongue) gules; if the tail is particularized, it is *queued* such or such a colour; while deers are so and so *attired*, if their horns are particularized. A head separate from the body is *cabossed*. So Mackenzie (Plate IV.) is blazoned *azure*, a stag's head cabossed *or*. A *holy lamb* is a lamb passant bearing a staff ending in a cross (Middle Temple).

Birds are *erect*, *inverted*, *close*, *volant* (Herondon, Plate IV.), *displayed* (Bedford, Plate IV., and Russia,

Plate V.), *regardant* (looking behind them), &c.; if they are birds of prey they are *armed*, of such and such a colour as to their claws and bills; if other birds, they are so *membered*. A peacock with tail displayed is *in his pride;* a pelican feeding her young is *in her piety*. A swan's head is always called a *swan's neck*. A cock is *crested* as to the colour of his comb. A *bird* simply is always of the shape of the blackbird; the colour as blazoned. A pair of wings separate are said to be *in lure*, as Seymour (Plate V.) Three ostrich feathers are a *plume* (Prince of Wales' badge, Plate I.) The cassowary is always heraldically called an *emu;* why, it is difficult to say.

Fishes, if in pale, are *hauriant* (Dauphin, Plate V.); if in fess, are *naiant* (Poole), *embowed* (also Dauphin), *respecting* (Colston), or *endorsed* (Phiert). Serpents knotted are *nowed*.

Of *inanimate charges* heraldry has many, especially of trees and flowers. These are *couped* (cut), *blasted* (leafless), *eradicated* (torn up), *pendent* (drooping), or *fructed* (with fruit). A wheat-sheaf is called a *garb*. The chief flowers used in heraldry are the *fleur-de-lis* (Royal France, Plate V.), the *rose* (Wolsey), and the various foils or leafy flowers, as *trefoil*, *quatrefoil*, *cinqfoil*, and sextile or *narcissus*, shown in the arms of Doctors' Commons and the following four escutcheons at the bottom of the Plate.

Monsters are prolific, heraldically. The *sagittary* (Stephen, Plate V.) was adopted by Stephen, because he landed in England under the sign Sagittarius. He only changed the heads of three leopards into archers *passant regardant*. The *double eagle* is shared by Austria and Russia, the latter already previously given. The *man-tiger*, the *dragon* (China, with four bird's feet, wings ribbed, and a serpent's tail); the *wyvern* of the Vandals, a two-legged sort of dragon; and the *triton* are shown in succession in Plate V. The *mermaid* is also a bearing often used. The *unicorn* of heraldry is a horse, tailed like a lion, with one straight horn (Harling), the *pegasus* (winged horse), the heraldic *antelope* (a wolf with a tusk and a lion's tail), the *gryphon* (an eagle in front, sometimes, however, with lion's legs, and a lion behind), the *salamander*, and the *phœnix* are successively shown (Plate V., Harling to Seymour). The heraldic *tiger* proper (not shown) is an absurd beast, having not the least relation to the real animal, except that it is a quadruped. It is an unfrequent bearing.

Artificial charges are countless. An imposing one is the *pall* (archiepiscopal garment) of Canterbury (Plate V.) A mark of high princely honour is the *annulet*, still held in the beaks of the eagles of Austria, already given.

The sun is usually *or*, and has often a face surrounded by wavy rays (*in his splendour*); the moon has a female face in her full circle (*in her complement*) and has straight rays, and also is shown as a *crescent*, an *increscent*, and a *decrescent* in the arms of Tutbury, Turkey, and Delaluna respectively. A star in heraldry should be wavy. If a star has plain points (usually five) it is a *mullet*, as in Bacon. Sun, moon, and stars are all shown in De Fontibus (Plate V.)

Marshalling.—The above is an abstract of the principal parts of blazonry, or the description of coat-armour. The second division of heraldry relates to the marshalling of those coats, whereby, the coat being unaltered, the wearer may yet be known as single or married, as in the main or collateral branch, &c. Family distinctions are shown by marks of *cadency* or *difference*, and are elsewhere described. [See DIFFERENCE.] Bordures are largely used for distinctions in family, as the Beauforts, who wear the arms of John of Gaunt, but with a bordure to mark the illegitimacy of their ancestor.

Females bear the arms of their father on a lozenge; and when married they impale them with those of their husband, the latter being on the dexter side. See Arms of Princess of Wales (Plate I.) This is impalement *per baron et feme*. Widows do the same, but on a lozenge. If a widower marries, he marshals his own coat between those of his wife's, his first wife being dexter. A remarkable coat is given by Gwillim of Sir Gervase Clifton, seven times married, with four coats on the dexter side of his own and three on the sinister. Only in case of superior rank of the wife are her husband's arms placed sinister to her own. In the case of an archbishop, bishop, &c., his arms are marshalled dexter, and the arms of the see, office, &c., sinister. In old times coats were often mixed, not impaled. Thus the three leopards of England were first definitely adopted by Henry II., whose arms only bore two on his marriage with Eleanor of Aquitaine, whose arms bore one. If a wife is an heiress her arms are now borne on an inescutcheon over those of her husband. If a change of name is made, as when the Spencers took the name of Churchill on succeeding to the title of Marlborough, the arms are quartered (as here Spencer and Churchill are).

Funeral escutcheons or HATCHMENTS are elsewhere described. *Abatements* or marks of disgrace, though nominally existent, are of course never used. One exception, however, we have seen (Grafton, Plate IV.), that is, the *baston* or *bar sinister*, indicating illegitimacy. *Crests*, *badges*, *mottoes*, and *supporters* are well known adjuncts of the shield proper. The use of supporters is limited to peers. The familiar lion and unicorn of the Royal Arms are examples of supporters. HELMETS in their heraldic sense are described in another article.

A few brief words on some changes in the arms of England will serve as a conclusion to this article. The Norman kings bore no hereditary arms. Stephen, as we saw, carried leopards on his shield, and Henry II. also (first two, then three). Richard Cœur de Lion changed them to lions, first two, then three, and "*gules*, three lions passant in pale, *or*" became the Plantagenet bearing. It passed thus, from the long rule of that dynasty, into a national coat. The French claim of Edward III. quartered upon them the lilies of France, "semy of fleurs-de-lis, *or*," in the first quarter. Henry IV. reduced this to "three fleurs-de-lis." The union of the crowns of Scotland and England, under James I., brought an alteration. The shield was now quartered—(1) the fleurs-de-lis of France; (2) the lion of Scotland in his tressure; (3) the harp of Ireland (*azure*, a harp *or*, strings *argent*), now borne for the first time, commemorating James' Irish settlements; and (4) the three lions of England. When the kingdom of Scotland was united to England, France was removed to the second quarter, and the arms of England and Scotland impaled filled both first and fourth. On the accession of George I. the Hanoverian coat filled the fourth quarter. At the union of Great Britain and Ireland, in 1801, the arms of France were for ever abandoned, England took the first and fourth quarter, Scotland the second, Ireland the third, and so they have since remained. While the English kings were kings of Hanover the Hanoverian arms were borne on an escutcheon of pretence.

HERALD'S COLLEGE, or **COLLEGE OF ARMS**, a corporation founded by Richard III., in the first year of his reign, by a charter dated the 2nd of March, 1483, in which he gives to the principal officers of the corporation a house called Colde Arbor, in the parish of All Hallows the Less, London; but in the first year of the reign of Henry VII. this house was taken into the king's hands under the Act of Resumption, as the personal property of John Writhe, then garter king-at-arms. During the reign of that king and of his successor Henry VIII. the heralds made several unsuccessful attempts by petition to obtain a restoration of the property, or the grant of some other building for their general use. King Edward VI., in the third year of his reign, by a charter dated 4th June, confirmed to them all their ancient privileges; and Mary, by

charter of the 18th of July, 1554, re-incorporated them, and granted to them Derby House, then occupying the site of the present college on St. Benet's Hill, near St. Paul's Churchyard. The old building was destroyed in the great fire of London, but all the books, papers, &c., were saved and removed to the palace in Westminster, where the heralds held their chapters, &c., until the college was rebuilt. The corporation consists of the heraldic officers of England under the presidency of the earl marshal, an office now hereditary in the Howard family, the dukes of Norfolk. [See HERALD.] Persons who have hereditary claims to arms which have been disused for one or more generations may be empowered to resume them by the Herald's College on satisfactory proof of their right being produced. Where there is no hereditary claim, and persons wish for arms, they have to memorialize the earl marshal and present proofs of fitness. The college records and traces pedigrees, and its members derive their incomes partly from salaries and partly from the fees they are entitled to charge for their services. The herald's college in Scotland is termed the Lyon Court.

HERAT' is a well-fortified city in the north-west of Afghanistan, 550 miles west of Cabul and 370 miles north-west of Kandahar. It now contains about 30,000 inhabitants, among whom are about 1000 Hindus and some families of Jews. It is inclosed by a thick wall, from 25 to 30 feet high, surrounded by a deep wet ditch. There are five gates, defended each by a small outwork; and on the north side there is a strong citadel, also surrounded by a wet ditch, which overlooks the town. The interior is divided into quarters by four long bazaars, covered with brick arches, which meet in a small domed quadrangle in the centre of the town. Many of the streets which branch off from the main ones are built over, and form low dark tunnels. The town is very dirty. It contains about 4000 dwelling-houses, many of them, however, being only built of mud, 1200 shops, seventeen caravanserais, and twenty baths, besides many mosques and fine public reservoirs of water. The manufactures are numerous, and include carpets, cloaks, caps, and leather goods. There is also a good trade in saffron and asafœtida, which are extensively grown in the vicinity. Herat possesses great political importance. It is considered the key to Afghanistan from the west; and as Afghanistan itself affords the only route by which a military force could advance by land towards India, it is sometimes called "the key of India," and its conquest by the Persians, who might allow the Russians to enter, has always been resisted by the British government, and was the occasion of a brief war in 1856.

HÉRAULT, a maritime department in the south of France, formed out of a portion of Bas-Languedoc, is bounded, N. by the departments of Aveyron and Gard, E. by that of Gard, S. by the Gulf of Lyons and the department of Aude, and W. by the departments of Aude and Tarn. Its greatest length from E. to W. is 84 miles, from N. to S. 49 miles. The area is 2393 square miles, and the population in 1881 was 441,527.

Surface.—The department is traversed in the north and north-west by the lower CEVENNES, which attain the height of 4198 feet in the Espinouse range on the confines of Tarn, and of 4264 feet in the chain of Larsac, or Larjac, extending north of Lodève into the department of AVEYRON. From the main chain several ranges of hills of moderate elevation branch off towards the south, gradually subsiding as they approach the sea. The cultivable soil of the north and north-west consists of a chalky clay which produces only rye. The higher mountains are in general barren or covered with woods. The plains in the interior, some of which are of large extent, consist of a light gravelly soil, very favourable to the growth of the vine and the olive. Along the lower courses of the Orb, the Hérault, and the Vidourle, and generally in the south of the department, the soil is strong, deep, rich, and very productive in all the cereal grains. Here and there all through the department there are extensive wastes, locally called *garrigues*, thinly covered with shrubs, dwarf oak, heath, broom, cistus, and aromatic plants, and producing tolerable pasture. The department presents abundant evidence of volcanic action at some distant period, particularly in the extinct craters of Agde and of St. Thibéry, near Pézenas, and in the basaltic hills near Montpellier.

The coast line, extending from the mouth of the Aude to that of the Vidourle, measures 66 miles in length. The salt lagoons of Thau, Maguelonne (so called from the ancient city of Magnelonne, which stood on the peninsula of Maguelonne, and of which there remains a very interesting church), Pérols, and Mauguio extend eastward from Agde to the Vidourle; they are separated from the Mediterranean by a narrow bank, in which, however, there are a few openings, called *graus*. The Canal des Etangs, which joins the Canal du Midi at Cette, passes through these lagoons. In the west of the department are the lagoons of Vendres and Capestang: the latter is land-locked and stagnant. The neighbourhood of all these lagoons is marshy and unhealthy; agues and rheumatic fevers prevail in the summer and autumn, though to a less extent than formerly, owing to the partial drainage and cultivation of the marshes. Except in the vicinity of the lagoons, the department enjoys a pure air and a most healthy climate.

Hydrography.—The rivers all rise in the Cévennes, and flow directly into the Mediterranean or into the lagoons. The principal are: the Vidourle, on the confines of GARD; the Lez, which passes east of Montpellier, and becoming navigable takes the name of Canal de Grave; the Hérault, which gives name to the department, rising in the north-west of Gard, running south, and entering the department of Hérault at Ganges, where, having received the Ergue on the right bank, it passes Montagnac and Pézenas, and enters the sea through the port of Agde after a course of 80 miles, only seven of which are navigable; the Orb, which, springing from the mountains west of Lodève, and flowing first south then west till it meets the Jaur at Olargues, and finally south-south-east, passes Béziers, having previously received the Bernasobre from the west, and enters the sea near St. Geniez; and the AUDE, which touches the western boundary. Near the coast most of the towns are joined to the Canals du Midi and des Etangs by short canals, thus establishing a communication with Beaucaire and the towns on the Rhone [see GARD] and the Garonne, and with the Gulf of Gascony.

Products and Resources.—About a fourth of the area consists of arable land, and a sixth of vineyards. Wheat, rye, barley, and oats are produced in quantity more than sufficient for the consumption. There is a considerable breadth of artificial meadows; and large crops of lucerne, sainfoin, and clover are grown. For the quantity of wine produced Hérault stands at the head of the wine-growing departments of France, the average annual produce being nearly 50,000,000 gallons. The red wines of St. Georges, St. Christol, and St. Drézéry, the muscatel wines of Frontignan, Lunel, and Béziers, and the white wines of Marseillan and Pinet, are considered the best. Fruits, especially raisins, olives, almonds, figs, and chestnuts, and all kinds of pulse are grown. The mulberry is cultivated for the production of silk; aromatic and medicinal herbs, and plants used for dye-stuffs, are gathered. The principal material of the woods are the chestnut and green and white oak. Sheep, cattle, and mules are numerous; game is very abundant; and fish, including the john-dory, tunny, oyster, lobster, anchovy, mackerel, eel, &c., are taken in immense quantities in the lagoons and in the sea.

The industrial products comprise woollen cloths for the army and for exportation to Spain and Italy, silks, hosiery,

calico, muslin, flannel, blankets, brandy, chemical products, pottery, tiles, honey, perfumes, leather, oil, beer, paper, &c. There are also numerous dye-houses and establishments for the rearing of silkworms. Shipbuilding is carried on at Cette and other towns on the coast. Mines of coal, iron, lead, and copper, quarries of marble, building and mill stone, slate, gypsum, and granite are worked. A great quantity of salt is made by evaporation on the lagoons and on the shore of the Mediterranean, this department being one of the chief sources for the supply of that article in France. There are several mineral springs. The exports consist of most of the articles enumerated, but chiefly of wines, dry fruits, and brandy. The imports are wool, cotton bales, staves, colonial produce, raw hides, cork, &c. The principal seaport is CETTE.

The department is divided into four arrondissements, viz. Montpellier, Béziers, Lodève, St. Pons. MONTPELLIER is the capital.

HERB, HERBA'CEOUS PLANT, is one in which the stem does not become woody, and dies down to the ground during the winter. Such plants may be annual, biennial, or perennial. Annuals spring from the seed, produce leaves, flower, and fruit, and die in one season; biennials produce leaves the first year, and flower and fruit in the succeeding season. The turnip, for instance, forms leaves during the vegetative stage, and accumulates a large store of nourishment in the root; in the wild state this nutritive material would be used up the next year in the formation of flowers and seeds, and then the plant would die. Perennials blossom and form fruit year after year.

HERBA'RIUM, a collection of dried plants, named and arranged in a systematic manner. The earlier botanists gave to such a collection the name of *Hortus siccus.* When the plants have been brought home in a vasculum, all their parts should be spread out, freed from folding and overlapping, put between folds of bibulous paper, and pressed. Having remained under pressure for a night, they should be put into fresh paper and again pressed. The paper should be changed till the plants are dry. When quite dry they are to be fixed permanently to paper by a little gum, named according to their natural orders, genera, and species, with the localities in which they had been gathered, and placed in the cabinet. It is also important to secure the roots of manageable herbaceous plants, and to mark the season at which they were gathered. The sheets of paper on which the plants are mounted should be stiff enough to bear handling; a useful size is 17 inches long by 11 inches broad. Not more than one species should be placed on the same sheet, but various stages in the growth of the plant may be represented, and also specimens from different localities. A label should accompany each specimen, giving name of collector, locality, and date. The name of the species is written at the bottom of the paper, and the various species of a genus are inclosed within a brown paper cover, with the name of the genus written on the outside at the bottom left-hand corner. The genera are arranged in natural orders according to some systematic work. In the British Museum herbarium at South Kensington, the plants of the general collection are arranged according to Bentham and Hooker's "Genera Plantarum," the number of the order and genus being placed outside each genus-cover; the collection of British plants in the same museum is arranged according to Babington's "Manual of British Botany."

HERBERT OF CHERBURY, LORD EDWARD, the earliest of the English deistical writers, was born of an ancient and noble family at Montgomery Castle, in North Wales, in 1581. He was sent to Oxford in his twelfth year, and at the age of fifteen he married his cousin Mary, an heiress, who was considerably older than himself. On the coronation of James I. he was made a knight of the Bath, and in 1608 he proceeded to Paris. The following year he joined the English auxiliaries in the Netherlands, and served under Prince Maurice of Orange, displaying the most reckless daring and intrepidity. In 1618 Sir Edward was sent ambassador to France; in this situation the bold independence with which he answered a remark of the Constable de Luynes brought upon him the displeasure of the French monarch, at whose request he was recalled. The conduct of Herbert met, however, with the approbation of James, who, upon the death of De Luynes, sent him again to Paris, where he published his first work, entitled "Tractatus de Veritate, prout distinguitur a Revelatione, a Verisimili, a Possibili, et a Falso" (4to, Paris, 1624). The year following he returned to England, and was created a baron of the kingdom of Ireland. In 1631 he was elevated to an English peerage, and two years after published an enlarged edition of the "Tractatus," of which another appeared in 1645, accompanied with the treatise "De Religione Gentilium, Errorumque apud eos Causis." Upon the outbreak of the political troubles under Charles I., Lord Herbert at first took the side of the Parliament, which, however, he subsequently abandoned at a great sacrifice of personal interests and fortune. He died in the year 1648. After his death two posthumous works were published, the "Expeditio Buckinghami Ducis in Ream Insulam," and the "Life and Reign of King Henry VIII.," with a dedication to the first Charles. His Memoirs, which are the earliest instance of autobiography in our language, remained in manuscript until they were printed in 1764 by Horace Walpole, at Strawberry Hill.

Herbert of Cherbury is now chiefly remembered as being almost the first of English thinkers who attempted to form deism into a system. His aim was rather constructive than critical, and it was his object to assert the sufficiency of natural religion, and to show that all extraordinary revelation was unnecessary and useless. In the place of Christianity he offered what he described as the universal religion, and the aim in all his philosophical writings is to expound its principles and to demonstrate its sufficiency for the needs of man. His works called forth several replies from Christian apologists, but they have now merely historical interest.

HERBERT, GEORGE, a celebrated English poet and divine, was born 3rd April, 1593. He was the fifth brother of Lord Herbert of Cherbury. He was educated at Westminster, and elected thence to Trinity College, Cambridge, about the year 1608. In 1611 he took his degree of bachelor, in 1615 that of master of arts, and in 1619 he was elected to the position of public orator of the university. He was patronized by Lord Bacon and also by James I., from the latter of whom he received a sinecure office worth £120 a year. On the death of James he studied for the church, took holy orders, and was made prebendary of Layton Bromswold, or Layton Ecclesia, in Huntingdonshire, in 1626. In 1630 he married Jane, the eldest daughter of his friend Mr. Charles Danvers, after a courtship lasting three days, with whom he lived in the greatest happiness for the short remainder of his life. He was appointed the same year to the rectory of Bemerton, where he died in 1633, in the thirty-ninth year of his age. He was a man of a pure and holy life, and his career as a clergyman was marked throughout by a consistent and self-sacrificing beneficence. His chief work, a collection of religious poems entitled "The Temple," was published a year after his death, and this, with a prose treatise entitled "The Country Parson," a poem entitled "The Church Militant," and a few minor verses, make up the whole of his writings. His poems include some of the sweetest passages of religious poetry in the English language; but considered as a whole, they are marked by great diffuseness and elaboration, and are overlaid with fantastic and sometimes incongruous imagery. A quaint and beautiful memoir of Herbert was written by Izaak Walton.

HERBERT, SIDNEY (Lord Herbert of Lea), statesman and minister, son of the eleventh Earl of Pembroke, was born at Richmond in 1810. Educated at Harrow and at Oriel College, Oxford, he entered the House of Commons in 1832 in the Conservative interest, as member for South Wilts, which he continued to represent until his elevation to the peerage. He was appointed secretary of the admiralty in Sir Robert Peel's ministry of 1841. In 1845 he became secretary at war, and went out of office with his party after the repeal of the corn laws. On the formation of Lord Aberdeen's coalition ministry he resumed his post of secretary at war. He was for a few weeks colonial secretary in the first administration of Lord Palmerston in 1855, and secretary at war in his second administration in 1859. His labours both in the House of Commons and in his office had so impaired his health that he was forced to resign his seat; and early in 1861 he was raised to the peerage. The state of his health compelled Lord Herbert to resign office and proceed to Spa, whence he returned to England, and died at Wilton, near Salisbury, 2nd August, 1861. To him were due the reorganization of the army medical department and of the militia, the organization of the volunteer force, the fortification of our dockyards, and great improvements in the sanitary condition and education of the army. He possessed winning and genial manners and a singular aptitude for business, was a good debater, an eminent philanthropist, and a liberal patron of the arts. He married, in 1846, the daughter of Major-general Ashe A'Court, of Amington Hall, Warwickshire, niece of Lord Heytesbury. There is a statue of Lord Herbert in front of the War Office in London.

HERCULA'NEUM, a very ancient Italian city, situated near the foot of Mount Vesuvius, about 4 miles from Naples. It derived its name from the worship of Hercules, which was peculiar to the place. Tradition attributed its foundation to the hero himself during his wanderings in the West. It was inhabited by Oscans, the aboriginal natives of the country, by Etruscans, and by Samnites, before it became subject to Rome. Owing to its salubrious situation on a height between two rivers, and being near the sea and the harbour of Resina, it became a favourite site for Roman villas (as that of Servilia, sister of Cato of Utica). The spot retained its name even after the total annihilation of the town by the eruption of 79. A number of poor families then took up their abode here, but in 472 their village was again destroyed by an eruption, which altered the configuration of the whole coast. Subsequent eruptions increased the depth of ashes and lava under which the old town was buried from 40 to 100 feet, that being the depth of the remains at the present day below the surface of the soil. The discovery of Herculaneum took place in 1713. Prince d'Elbœuf of Lorraine, while erecting a casino at Portici, caused a well to be dug to supply it with water. This led to the discovery, at a depth of about 90 feet, of the ancient theatre, where a number of statues were found. Two of these, beautiful portrait-statues of an old and a younger woman, are now in the museum at Dresden. During the next twenty years the excavations were discontinued, but in 1737 Charles III., when engaged in erecting a palace at Portici, recommenced operations, which were unfortunately directed by unskilful hands and led to no satisfactory result; nor was it an easy task to remove the huge masses of tuffstone and lava which covered the ruins, especially as the buildings and streets of Portici and Resina were thereby undermined. In 1750 a long narrow passage was hewn through the rock leading to the theatre, which lies 69 feet below the level of the street, and this is the entrance at the present day. In 1755 the Accademia Ercolanese was instituted for the investigation of the antiquities discovered, and under their auspices was published the "Pitture d'Ercolano" in nine volumes (Napoli, 1757), which caused immense sensation in the learned world. The excavations during the next fifty years were conducted too superficially and unsystematically, but progressed more favourably under the French kings Joseph Napoleon (1806–8) and Joachim Murat (1808–15). Under the Bourbons operations were suspended till 1828. Many of the most interesting objects were excavated and again covered; thus the theatre, part of the forum with its colonnades, a basilica similar to that at Pompeii, private houses, &c. Although the works were carried on without any definite plan, the yield was remarkably rich, and has furnished the museum of Naples with a large proportion of its most valuable treasures, including statues, busts, mural paintings, inscriptions, and utensils of all kinds. In the chamber of one house an extensive papyrus library of 3000 rolls was discovered. The excavations were recommenced with great ceremony in 1868, but as they are conducted on a limited scale no great results have yet been obtained. In due time, however, a number of interesting discoveries may confidently be expected. This is all the more likely as the ancients appear soon to have given up their search for objects of value here as being unprofitable; and while Pompeii was thoroughly explored and ransacked, the treasures of Herculaneum have been preserved for the benefit of posterity by the mantle of lava with which they are enveloped. The theatre contains nineteen tiers of seats in six compartments (Lat. *cunei*): between these seven flights of steps ascended to a broad corridor, above which was situated a colonnade with three more tiers of seats. The number of spectators it could contain has been variously computed at from 8000 to 30,000, the latter number being certainly too high. The orchestra lies 85 feet below the level of the modern town of Resina, and is faintly lighted from above through the shaft of the well which was the occasion of the discovery. The stage was 33 metres long. One inscription records that L. Annius Mammianus Rufus erected the theatre; another that Numisius, son of Publius, was the architect. The buildings brought to light by the *Scavi Nuovi* of 1828 to 1837, and resumed in 1868, are of far higher interest. A street, part of a large private house, and several houses used for trading purposes have been excavated. They lie 40 feet below the present surface, and the different layers of the superincumbent lava are readily distinguished. The houses with their fittings and decorations resemble those of Pompeii. The garden of the principal house, that of the Argus, is one of the most interesting objects. It is inclosed by an arcade of twenty columns and six buttresses. Towards the sea, the proximity of which at that period is indicated by the rapid descent of the street, are situated magazines, three storeys in height, and well preserved.

HER'CULES. See Herakles.

HER'CULES, one of the old constellations, known to Aratus, Hyginus, and Ptolemy, but variously described by them. The club, lion's skin, and figure of Hercules are not so old as Aratus, who describes this personage as stretching his hands to different quarters, and makes an allusion to the neighbouring dragon, which shows that he was not painting a hero. The constellation is situated between Draco, Boötes, Lyra, and Ophiuchus; but as there is no star in it larger than that of the third magnitude, there is nothing very remarkable about it. The principal stars, α and β, lie between the bright stars in the head of Ophiuchus and in Corona Borealis. See Plate Constellations, Northern Hemisphere, opposite xvii.

HERED'ITY. The fact that certain conditions of the body are transmissible by inheritance is one that has long been recognized both in connection with animals and men, but the laws by which this influence is controlled and the modes of its manifestation are at present but imperfectly understood. In the case of those animals which have been

domesticated the importance of this law is fully recognized, and by the careful selection of certain types for several generations many very striking results have been obtained. This is especially the case with horses, dogs, and birds, in all of which variations in shape, colour, and character can readily be produced by experienced breeders. The more complex nature of man, however, presents greater difficulties to investigation; and though it is abundantly manifest that hereditary transmission affects both his physical and mental constitution, there are many points connected with it that cannot at present be explained. We all recognize that children often greatly resemble their parents, exhibiting similar features, tones of voice, walk, manners, &c.; that certain peculiarities of feature may run in families, and even be transmitted for several generations. Sometimes characteristics derived from both parents may be traced in a child; sometimes the influence of one parent is evidently predominant, while often one or two inherited traits or physical peculiarities may be observed, and we are at a loss to account for the origin of other and more strongly marked qualities. It may be, however, fairly presumed that these are derived from earlier ancestors, for a child is often observed to exhibit peculiarities or qualities resembling those of a grand-parent; and though personal observation can seldom go beyond this relationship, there is no reason for doubting that tendencies may be derived from ancestors much more remote, and possibly from several of them. By some expositors it is supposed that one form of this law, observed from very early times, is the penalty attached to the breach of the second commandment (Exod. xx. 5); but however this may be, that the consequences of wrong-doing affecting the physical system may be transmitted to the third and fourth generation is a fact fully recognized by every physiologist. While, however, physical peculiarities naturally acquired are readily transmitted to offspring, and this even in such cases as depart from the normal type, peculiarities accidentally induced are not hereditary. The contrary has been asserted by some eminent physiologists, who have maintained that where parents have lost fingers, &c., or have suffered from injuries that have left special and striking marks upon them, such losses or marks are often inherited by their offspring. That numerous facts which appear to support this theory can be produced must be admitted; but on the other hand, the powerful influence exercised by maternal impressions during pregnancy must be taken into account, and there are more numerous and more important facts which point in the opposite direction. Thus with certain breeds of dogs it has been the custom for generations to dock their ears and tails, but the same thing must be done to every fresh litter of puppies that is produced, inasmuch as, notwithstanding the mutilation of the parents, the offspring are never born without these useful appendages being of the natural length. In the human race also many deformities are intentionally produced in obedience to the dictates of fashion, as for instance the rounded and compressed waists of European ladies, the clubbed feet of those of China, and the flattened skulls of certain tribes of American Indians, but these distortions are only partially transmitted to the offspring.

Concerning the mental qualities, it is fully proved that these may not only be inherited from the parents, but also from ancestors one or more generations further back. This has been observed very clearly in connection with some breeds of dogs, as for instance pointers and sheep-dogs, in which the formation of what we may fairly term mental habits has been encouraged for generations. In the human race it has also been observed that the children of skilled artisans take to trades similar to those of their fathers with much greater aptitude than the children of labourers, or those who have pursued avocations of a different character. As an artisan expressed it in conversation with the writer, such children when apprenticed "take to their tools naturally and soon learn everything;" while those of different parentage often handle their tools awkwardly and learn slowly and with difficulty. In other ranks of society it is evident that mental qualities are often transmitted in a similar way, and special aptitudes for certain forms of intellectual work, for the arts of music and painting, for the profession of arms, &c., are found to be the possession of certain families.

Moral qualities also are conveyed by inheritance, and hereditary tendencies both towards good and evil probably enter into the composition of every individual character. Such qualities as courage, magnanimity, truthfulness, perseverance, &c., may often be traced in this way as clearly as the possession of physical peculiarities, and so with equal certainty may tendencies to certain forms of crime, or to criminality generally. We cannot in this place enter into any consideration of the perplexing questions as to the limits of the power of the individual will or of personal responsibility which are suggested by these facts, but their reality is fully sustained by history, biography, and by the accumulated records of the doings of the criminal classes, whatever opinions may be based upon them. This much may be said, that a fearful Nemesis waits on whatever social community commits the crime of neglecting its pauper or criminal classes. Inherited beggary or crime becomes then at length a part of the body politic, which can only be coped with by heroic measures. On the other hand, national education, such as that long enjoyed by Scotland and now shared in by England and Ireland, attacks these hereditary tendencies with the happiest effect, especially when not one generation alone but a reasonable lapse of time is taken into consideration.

The importance of heredity in connection with the transmission of disease, or of such a form of bodily constitution as will readily succumb to adverse influences and develop special maladies, is fully recognized in medical science. Some complaints fortunately appear to be incapable of being handed down in this way; but there are many in which the power of a hereditary taint is very strongly marked—consumption, cancer, goitre, gout, insanity, and syphilis being among the most prominent. Such tendencies are intensified by intermarriages among families in which these have been manifested, while they tend to die out where unions are contracted with more healthy stocks. The disastrous effects of the hereditary transmission of disease intensified by a continuance of the unhealthy conditions by which it was first induced, and by intermarriage, are seen in the cretinism which prevails in some of the Alpine districts, and which has already been noticed. [See the article CRETINS.] In cases of insanity it has been observed that a large proportion of those affected are the descendants of families in which brain and nerve disease has been manifested; and further, that the neurotic taint is more frequently to be traced through the mother than the father. Thus the marriage of Henry V. to the daughter of the mad King Charles of France inflicted a mad king upon England in the person of Henry VI., and deluged both France and England with blood.

Diseases that are hereditary usually manifest themselves at an earlier period of life than those which are acquired, and they are generally more obstinate and difficult to treat. It must not be supposed, however, that such diseases are uncontrollable, or that where a hereditary tendency exists that it is bound to manifest itself. On the contrary, it has been incontestibly proved that such a tendency may often be kept in check by the adoption of proper rules of living, and where these are persisted in long enough the taint may be destroyed or neutralized altogether. The knowledge that there is a special liability through inheritance to a particular form of disease certainly calls for a careful avoidance of any mode of life that has a tendency

to develop it, and for the use of all such means as may be available to counteract its influence, and such efforts are often attended with the happiest results.

The probable effect of one's conduct upon his posterity has during recent years been the subject of much earnest study, and it enters very largely into the theory of EVOLUTION. The religious influence excited by this simple and plain scientific theory is highly remarkable. The duty of self-control and of self-improvement for the sake of those to come after us—that is to say, the consideration of our race rather than of our single selves—is now a common feeling among thousands where direct religious teaching had been hitherto vainly striving to get more than a mere perfunctory assent. Darwin has attacked the practical side, so powerful in the English character, and the clergyman now finds his exhortations acted upon as well as listened to. Men preached temperance for ages, till it was shown that the children suffered from the intemperance of their parents; that once done, the very next generation (our own) sees intemperance greatly diminish as a national crime. Anyone knowingly consumptive, or tainted with madness or the like, who now marries is held not to be an object of pity, as heretofore, but of strong moral reprobation. Marriages of first cousins, once the favourite theme of novelists (Lytton in "The Caxtons," Dickens in "Bleak House," Thackeray in "The Newcomes," &c.), and hence fairly to be judged as appealing to the favourable sympathies of our fathers, are now condemned as reckless hardihood, where they are not silently passed over as too absurd for sensible persons. It is now clear, and is within the observation of nearly everyone, that such marriages are very frequently disastrous, from their intensification of whatever family taint may lurk concealed. The works of Francis Galton on "Hereditary Genius" and "Inquiries into Human Faculty and its Development" (Lond. 1883) contain most remarkable and patient investigations into several departments of this obscure but deeply interesting subject. The fullest statement of the modern philosophical position is that by Herbert Spencer ("Biology," part ii. chap. 8, London, 1870). The "Heredity" of M. Ribot (Paris, 1873) is also very accurate and full. The physiological side is exhaustively treated in principle in Darwin's "Descent of Man," second edition (Lond. 1875).

HER'EFORD, a county of England, is bounded E. by Worcestershire and Gloucestershire; N. by Shropshire, with a portion of Worcestershire; W. by Radnorshire, Brecknockshire, and a part of Monmouthshire; and S. by Monmouthshire and Gloucestershire. The length, north to south, is about 40 miles; the breadth, west to east, 34 miles. The area is 860 square miles, or 532,898 acres. The population in 1881 was 121,062.

Surface, Rivers, &c.—The surface of this county is generally hilly, but the valleys occasionally expand into open plains. The Hatterel range of the Black Mountains, which forms its border on the west-south-west, is the highest land within its limits; there is likewise a third and lower line of hills extending in the same direction from Middlewood to Wormbridge. In the south-west the Saddlebow and Garway are conspicuous, and in the south the hills near Walford and Penyard. The Malvern Hills and the range stretching northward from Stamford Bishop are the principal heights on the eastern boundary. On the north are the hills of Downton and Leintwardine, together with the range running in a south-west direction from Ludlow. Near the centre of the county Dinmore, Westhope, and Badnage Hills, with the line on which the circle of firs called Lady Lift stands conspicuous, form the most prominent features.

No large rivers have their source in these hills; the principal streams which water Herefordshire rise in the higher counties of South Wales. They are, the Wye, the Lugg, the Teme, the Arrow, the Frome, the Leddon, the Doyer, and the Munnow.

The Wye, which rises in Cardiganshire, enters Herefordshire on its western side, and after many windings reaches the city of Hereford, and finally leaves the county near the Leys. It is imperfectly navigable throughout the whole of this county. The immediate vicinity of mountains, and the very large surface of country drained by the Wye, cause sudden and frequently destructive floods. For picturesque beauty this river is justly celebrated. Trout, grayling, and salmon are taken. Since the destruction of a weir in the lower part of the river the number of salmon has increased. Neither of the other rivers is navigable to any useful extent; they are chiefly remarkable for their plentiful supply of fish. Two canals have been formed through portions of this county for the conveyance of coal and other heavy goods, and it is also well supplied with railway accommodation.

Climate, Geology, and Agriculture.—The climate of Herefordshire varies greatly, according to the elevation and exposure. The neighbourhood of Ross and Ledbury, as well as the central portion of the county, enjoys a superior climate to such portions of the north and west as are in the vicinity of Wales; but the general climate of the whole county is remarkably healthy.

Most of the surface of this county belongs to the old red sandstone formation, but the highest points are of the class of Silurian rocks. These are Marcle Hill, near Ross, on the Wye, and the range between Ludlow and Kington. The Black Mountains, on the Breconshire border, are 2545 feet high; and the Wye cliffs are 2000 feet at Symond's Yat.

The soil consists principally of a deep and heavy loam, with a substratum of clay in some districts and gravel in others. The high lands are generally occupied by oak coppices, which are numerous and extensive. The county is essentially an agricultural one. Although it cannot be placed in the very first rank, the farming is generally good, and improvements are continually being introduced as regards methods of culture and new implements; but the farm buildings and labourers' cottages are not, as yet, as good as those of many other counties. According to the official agricultural statistics published in 1885 there are 445,000 acres under cultivation; corn is grown on 100,000 acres, green crops on 33,000 acres, clover on 34,000 acres, hops on 6000 acres, and 265,000 acres are permanent pasture. The apple crop yields about 20,000 hogsheads of cider. Perry is also extensively made.

The county is celebrated for its cattle, which are red, with white or mottled faces, and occasionally some white about the legs. They are generally preferred for grazing, not being good milkers. The breed of sheep is very generally held to be as celebrated as that of the cattle. Dairy farming is never practised here, and the milk of the cows, which are only kept for breeding, is given to the calves. The oxen are generally fed at two years old, and sent to market at three. Agricultural horses of average quality are bred in considerable numbers. The north part of the county produces useful riding and coach horses. The number of cattle in the county in 1885 was 82,000, and of sheep 270,000. The manufactures are almost entirely confined to such articles as are required for local consumption, and there are no mines.

Herefordshire is divided into eleven hundreds and 221 parishes. The county returns two members to Parliament under the Seats Act of 1885, the number of electors in 1886 being about 8840.

History and Antiquities.—The greater part, if not the whole, of Herefordshire was comprised in the territory of the Silures, and was conquered by the Roman general Julius Frontinus about A.D. 73. A line of Roman and British entrenchments may be traced from the Malvern Hills to Whitbourn, Thornbury, Croft, Brandon (near Leintwardine), and Coxwall Knoll (near Brampton Brian). There are also traces of a camp on the east of Leintwardine,

near Downton, and several Roman roads in various parts of the county. During the Heptarchy Herefordshire belonged to Mercia, and in 680 a synod was held at Hereford, which was the principal town of Mercia in the time of Offa.

The position of Herefordshire relative to Wales subjected it to continual inroads from the Welsh. A considerable part of the county was included in the "Marches," a term used to express the frontier in dispute between the Welsh and the English. In spite, however, of repeated defeats of the Welsh, and very severe exactions, attacks continued to be made upon the persons and property of the Marchers; but no event occurred which immediately affected this county until the crown of England was in dispute between Stephen and Maud, the daughter of Henry I. Geoffrey de Talebot and Robert, earl of Gloucester, then declared in favour of the empress. Talebot retired to Hereford, but soon quitted it, and the Castle of Weobly, which had been garrisoned against Stephen, was totally demolished. Stephen afterwards invested the city of Hereford.

During the troubled times of Edward II. Herefordshire was the scene of many executions. The king's adherents, Hugh Despenser, Baldoc, and Reding, were executed at Hereford. No particular event occurred by which the county was locally affected until the rebellion of Owen Glendower threw the Marches into confusion.

During the wars of York and Lancaster Herefordshire did not escape the general commotion. During the Civil War the city of Hereford was garrisoned for the king, but was taken by Sir William Waller. After the battle of Naseby the king marched to the relief of Hereford, and the Scotch army raised the siege. In the course of the year 1646 the city was taken by surprise, and the whole county was reduced by detachments in the interest of the Parliament, under the command of Sir William Waller and Colonel Birch. There were several castles in Herefordshire, of which a few ruins remain, but most of them have been demolished. The only Druidical remains are a pile of stones, called Arthur's Stone, situated in the parish of Dorstone.

HEREFORD, an ancient city and parliamentary and municipal borough, and capital of the above county, is situated on the left bank of the Wye, 134 miles W.N.W. from London by road and 144 by the Great Western Railway. The city, as a municipal borough, is divided into three wards, and is governed by six aldermen and eighteen councillors. The parliamentary borough returns one member to the House of Commons. The population in 1881 was 19,281, and the number of voters averages about 3000.

In early times this city was important as a garrison to restrain the Welsh. The castle consisted of two wards of different dimensions, having a keep within the smaller: the Wye formed its defence on the south side; on other points it was defended by moats. The principal events of its history are its pillage by the Welsh in 1055; its capture by King Stephen in 1141; the execution of Owen Tudor in 1461; the surrender of the city, in 1643, to the parliamentary troops headed by Sir William Waller; and its siege, in 1645, by the Scotch under Lord Leven. Hereford is situated in a broad, fertile, and well-cultivated valley, and at sufficient elevation above the river Wye to be free from fogs and damp. The principal streets are broad and straight. The private houses, with few exceptions, are built with red brick, and the public buildings of stone. The shire-hall was built after a plan of Sir Robert Smirke, and is remarkable for its unassuming beauty and good arrangement. Within the last few years the town has been greatly improved by the erection of a new market-house with clock-tower, new and extensive cattle-market, new corn-exchange, and several large and handsome shops and buildings. The cathedral stands upon the south side of the city, not very far from the Wye. The date of the original building is fixed at 825; the whole was rebuilt by Bishop Athelstan about the year 1030. This cathedral was entirely demolished in 1055. No renewal was attempted until the latter years of William the Conqueror's reign, when Bishop Lozing and others commenced the present building. In 1786 the western portion of the cathedral fell, and alterations were made; the spire was removed, and a new western end added by Wyatt. It underwent a thorough restoration, under the superintendence of Sir G. Gilbert Scott, and is now admitted to be one of the best of its kind—considering its size—in the kingdom. The present length of the entire building is 320 feet, and the height of the central tower 160 feet. The cathedral contains many monuments of great antiquity, some of which are highly ornamented. Attached to it is a chapter-house and library, containing a curious map of the world of the thirteenth century, and other geographical works. The diocese of Hereford is one of the most ancient in England, being of British origin, and re-established by the Saxons in 680. It comprises the two archdeaconries of Hereford and Salop, including thirteen deaneries, which extend partly into the counties of Radnor, Stafford, Montgomery, and Worcester.

In front of the town-hall is a handsome statue of Sir George Cornewall Lewis, by Baron Marochetti. A spacious free library and museum was erected and presented to the city in 1875, by Mr. J. Rankin. There are several hospitals or almshouses and a gaol. A handsome county lunatic asylum was built in 1872. The principal churches are those of All Saints, St. Peter, St. Nicholas, and St. John. In addition to the churches, there are places of worship for the principal denominations of dissenters—some of them very handsome buildings—and an ornate Roman Catholic chapel and Benedictine monastery. A triennial musical festival is held at Hereford. The episcopal palace is ancient, and surrounded by large gardens; the college forms a quadrangle. There are manufactures of gloves, hats, flannels, and cutlery; and a trade in cider, hops, corn, wool, bark, and timber. The October fair held here is one of the largest in England for cattle and cheese. Hereford was the birthplace of Nell Gwynn and David Garrick.

HER'ESY, HER'ETICS. The word heresy (from Gr. *hairesis*, choice) was originally used to express any opinion which a man adopted. In this sense it was applied to the philosophic sects of Greece and Rome (Cicero, "Paradox, Proëm.") In the New Testament the term often simply denotes a religious party, without implying any censure (Acts v. 17; xv. 5; xxvi. 5; xxviii. 22). In most of these passages the translators use another word, to avoid being misunderstood; as, "after the most straitest sect (heresy) of our religion I lived a Pharisee" (Acts xxvi. 5). Josephus calls the three great Jewish sects *heresies* ("Antiq. Jud.," xiii. c. 5, s. 9). But it is also used in the New Testament as a term of reproach, and as such was applied by the Jews to Christianity (Acts xxiv. 5, 14), and by the apostles to those who resisted their doctrines (1 Cor. xi. 19; Gal. v. 20; Titus iii. 10; 2 Peter ii. 1). The fathers applied the words heresy and heretics respectively to opinions which were different from what they considered the doctrine of the apostles and to those who held such opinions, though some of them drew a distinction between heresy as a wilful rejection of the doctrines of Scripture, and errors arising from ignorance or weak judgment. When the creed of the church began to be settled by ecclesiastical councils, all who refused to submit to their decisions were denounced as heretic—they were also called *heterodox*; while those who adhered to the opinions of the church were called *orthodox* or *catholic*. Heretics were distinguished from unbelievers, inasmuch as they professed Christianity. Heresy must not be confounded with schism: the former relates to doctrine; the latter is any division on points of discipline. The number of heresies mentioned by

early ecclesiastical writers is from eighty to 150, but Lardner ("Hist. of Heretics," i. 5) has shown that many of these ought to be excluded from the list; nor have we any evidence that many of them had numerous followers. The most important of the various sects generally included under the term are treated of under their respective names.

The chief heretics of the *first century* were the Simonians, followers of the impostor Simon Magus, whom St. Peter is believed to have confronted before the emperor; the Corinthians (led by Cerinthus, whom St. John is held to have personally contended with and refuted), precursors of the Gnostics; the Ebionites (Gr. *Ebionim*, the poor folk), and the Nicolaitans (Nicolaos).

Those of the *second century* were the Basilidians (led by Basileidês), Carpocratians (Carpocratês), Valentinians (Valentinus), Gnostics, Nazarenes, Millenarians, Cainites (Cain), Sethians (Seth), Quartodecimans (keeping Easter on the 14th day of March), Cerdonians (Cerdôn), Marcionites (Marcion), Tatianists (Tatian), Alogians (Gr. *a logos*, denying the Logos or Word); the Montanists (Montanus), who boasted a pope (Victor) and a father (Tertullian) among them; the Artotyrites (sacrificing with bread and cheese to God—Gr. *artos*, bread; *tyros*, cheese), a class of Montanists; and the Angelics, or angel worshippers.

Those of the *third century* are the Monarchianists, holding the nature of God indivisible, whom their enemies called Patripassionists (Lat. *Patris passio*), because, said they, this is equivalent to asserting that God the Father suffered on the cross; the Arabicans, the Aquarians, the Novatianists (led by Novatian, the first anti-pope), the Origenists (Origen), the Melchisedechites (holding that patriarch as the Messiah), the Sabellians (Sabellius), who were substantially Unitarians, and the Manichæans (Mani). The latter disowned the Christian name, but are usually reckoned as heretics.

The heretics of the *fourth century* were the Arians (following Arius in denying the Godhead of Jesus), who at one time threatened to overthrow the orthodox altogether, so powerful did they become; Colluthians (Colluthus), Apollinarians (Apollinaris), Collyridians (who sacrificed with cakes, *collyrides*, to the Virgin Mary), Seleucians (Seleucus); Priscillianists (Priscillian), a revival in many things of the Manichæans; Anthropomorphians (Gr. *Anthrôpos morphê*), ascribing a definite human form to God; Jovinianists (Jovinian), Messalians, and Bonosians (Bonosus).

The heretics of the *fifth century* were the Pelagians (Pelagius), Nestorians (Nestorius), and Eutychians (Eutyches). The Nestorians taught that the divine nature was added on to the human nature in Jesus; the Eutychians in refuting them went to the opposite extreme, and declared that Jesus had but one nature, whence they were called *Monophysites* (Gr. *monos*, one; *phusis*, nature).

The heretics of the *sixth century* were the Predestinarians, the Incorruptibilists, holding Christ's body to be incorruptible, the Agoêtæ, who taught that Christ was not informed as to the date of the last judgment, and the Monothelites. These last were even more powerful for a time than the Arians had been, for early in the *seventh century* the Emperor Heraclius, the Patriarch Sergius, and the Pope Honorius I., were all Monothelites, and it seemed as if Monothelism would become a settled doctrine of the church. Eventually, under the successors of Honorius, the West revolted, and at the close of the seventh century an orthodox emperor (Constantine the Bearded) was found wh brought back the East to orthodoxy, and the Monothelites (Gr. *monos*, one; *thelos*, will), including Pope Honorius, were condemned as heretics at the Council of Constantinople, 680. They were the middle party between the Monophysites and the orthodox: agreeing that Christ had a twofold nature, but asserting the unity of his will.

In the earliest times heresy was punished with ecclesiastical censures only. An obstinate offender was cut off from communion with the church, and he was prohibited from attending any of its services, while a father was forbidden to allow either his son or his daughter to marry one who had been declared a heretic, and the members of the church generally were forbidden to have any intercourse with such persons. When Christianity became the established religion of the Roman Empire, civil punishment was also awarded to the crime of heresy. Constantine enacted severe penalties against heresy, and ordered all persons who possessed heretical books to burn them under pain of death. Similar laws were frequently passed during the subsequent period, and at the breaking up of the Roman Empire they passed into the various codes of the European kingdoms. The principle that a heretic was in some sense a treasonable person, or an offender against the authority of the ruler and the well-being of the state, is found pervading the whole system of mediæval law, and the most terrible and awe-inspiring punishments were awarded to all such persons. Hence most of the mediæval heresies took the form of a revolt at once against the church and state—the sects which arose were revolutionary as well as opposed to the teaching of the church. The procedures against heresy, and the awful persecutions awarded to those who were charged with that offence, form a mournful chapter in the history of the middle ages, and the saddest portion of the story is that which centres around the INQUISITION. It must, however, be remembered that while the punishment awarded to heresy was of a cruel and excessive character, the same must be said of the enactments against all criminals during the same period, and even against such as from helplessness and poverty were rendered beggars.

Before the Reformation in England, heresy was the holding of opinions contrary to the Catholic faith and the determination of holy church; at least this is the definition of heresy in the celebrated Act De Hæretico Comburendo (2 Henry IV. c. 15). It seems probable that a writ of that name had been used before by which the offender after condemnation was delivered up to the king for punishment, but by this Act it became competent for a diocesan alone, without the verdict of a synod, to pronounce sentence of heresy, and at once hand over the offender to the sheriff for the execution of the sentence. One Sawtree, it is said, was the first man burnt alive for heresy in England, and the writ De Hæretico Comburendo was framed for his case.

The Act 1 Eliz. c. 1 repealed all former statutes about heresy, which was accordingly punished, after the Reformation was fully established, by ecclesiastical censures, and by burning alive a criminal who had been convicted, in the manner above ascribed, in a provincial synod. The writ for burning the heretic could not be demanded as a matter of right, but was left to the discretion of the crown; and both Elizabeth and James I., in their discretion, thought proper to grant the writ. Elizabeth, it is said, burnt alive two Anabaptists, and James burnt alive two Arians. The statute of 29 Car. II. c. 9 abolished the writ De Hæretico Comburendo. Heresy is now left entirely to the judicial committee of the Privy Council; and the punishment of death in consequence of any ecclesiastical censure was by that Act abolished in England. As Elizabeth and James practically showed their approbation of burning heretics alive, so Lord Coke (3 "Instit.," c. 5) approves of the punishment.

Since the passing of this statute heresy has been a purely ecclesiastical offence in England, and there is no risk in asserting that much of the jurisdiction of the judicial committee of the Privy Council in respect to heresy, whether it shows itself in speaking, writing, or preaching, has been destroyed by the various Toleration Acts. So far as laymen are concerned the temporal courts do not recognize any such offence as heresy, though according to the letter of the law an ecclesiastical court might, on a case being proved, pass sentence of excommunication. It is a

doubtful point even whether a clergyman could refuse the communion to a parishioner on the ground of any theological opinion alone, and many authorities favour the view that the right of a layman to the offices of the church exists without reference to opinions at all. The case is different of course with regard to the ministers of the Established Church, who are liable to be deprived of their ecclesiastical promotions in the event of their teaching heretical doctrines. But even with regard to clergymen a large toleration has been established both legally and in the court of public opinion, and though wide divergences of opinion exist, and are freely expressed concerning many points of doctrine formerly considered fundamental, prosecutions for heresy are of very rare occurrence. The history of the law relating to heresy in England is instructive, and the change from burning alive for such an offence to the almost unrestrained expression of opinion on religious manners, forms one of the most striking signs of modern social and intellectual progress.

HER'IOT is a feudal service consisting of a chattel which is given to the lord on the death of a tenant, and in some places upon alienation by a tenant. Heriots are either heriots-custom or heriots-service. A heriot due from the dying tenant by reason of his relation of tenant within a particular manor or other district, is called *heriot-custom; heriot-service* is a heriot due in respect of the estate of the tenant in the particular land held by him. The corresponding Scotch law term was "herezeld." It was not a feudal exaction, but a claim due to a landlord on the death of his agricultural tenant. It meant the best horse, ox, or cow that belonged to the deceased tenant. It has long been practically obsolete.

HER'IOT, GEORGE, founder of the excellent hospital in Edinburgh which bears his name, was born in June, 1563. His father was a goldsmith in that city, who filled several of the most important civic offices, and represented the metropolis in several Scotch Parliaments. George Heriot the younger was bred to his father's occupation, which was at that time highly lucrative and was connected with the profession of a banker or money-lender. In 1586 he married Christian Marjoribanks, daughter of a respectable burgess. In 1597 he was appointed jeweller to the queen, Anne of Denmark, consort of James VI. of Scotland—who became James I. of England—and shortly after to the king. Her Majesty's account to him for a space of two years amounted to nearly £40,000. On the removal of the court to England, Heriot of course followed the fortunes of his royal master. He had now accumulated a large fortune, and chose for his second wife Alison, daughter of James Primrose, clerk to the Privy Council, and ancestor of the Earl of Rosebery. But he was deprived of this lady also by her dying in childbirth in 1612, in her twentieth year. "The loss of his young, beautiful, and amiable partner at a period so interesting," Sir Walter Scott conjectures, was the probable reason which induced Heriot to devote his fortune to a charitable institution. After leaving considerable sums to his various relations, this munificent philanthropist bequeathed the remainder of his large estate to establish an hospital for the gratuitous education of the sons of Edinburgh freemen. The building —a magnificent quadrangle of the Gothic order—is said to have been designed by Inigo Jones in 1628, but was not completed till 1659. It is under the management of the lord provost, magistrates, and town council and the Established clergy of Edinburgh. So largely have the funds increased, that they not only support and educate most efficiently 216 youths annually, but they also maintain in the highest state of efficiency a number of schools in different parts of the city, attended by over 5000 children, and a number of schools for gratuitous evening instruction, attended by upwards of 1000 young men and women. Provision is also made for the most promising scholars of the hospital completing their education at the University of Edinburgh, while others receive apprenticeships to various trades and their outfits on leaving the hospital. The founder of this noble charity—"Jingling Geordie," as King James termed him—was a great favourite with his Majesty. An admirable portrait of him has been drawn by Sir Walter Scott in the "Fortunes of Nigel."

HERITABLE BOND. See HERITABLE SECURITIES.

HERITABLE JURISDICTIONS, in Scotch law, were grants of criminal jurisdiction formerly conferred for distinguished military service, along with the lands to which they were attached, on certain great families, in order to expedite the administration of justice throughout the land. As the lands were made over not only to the grantee, but to his heirs, the jurisdictions annexed to them were consequently heritable. These jurisdictions, becoming in course of time a source of great abuse, were abolished, along with other powers conferred on landed proprietors, shortly after the rebellion of 1745, by the Act 20 Geo II. c. 43, compensation being given to those who suffered patrimonial loss by the operation of the statute.

HERITABLE SECURITIES, in Scotch law, are various modes in which lands and heritages may be rendered a source of credit to their proprietors. The real right may be constituted by registration of the bond or sasine in favour of the creditor, or be dependent on the force of a condition simply qualifying the right of property. The principal ways in which heritable securities may be created are:—

1. By *wadset*, an *ex facie* irredeemable right in favour of the creditor, but qualified by a separate deed conferring the right of reversion on payment of the debt for which the lands were impledged. This form is now rarely met with in practice.

2. By *real burden* specifically imposed by the disposition upon the lands, and binding upon the disponee and his heirs.

3. By *heritable bond*, a deed in which the debtor binds himself to repay the principal sum with interest, and grants obligation to infeft the creditor in an annual rent payable out of the lands during the non-payment of the principal sum. This security is of the nature of a real burden, and is completed by infeftment in the person of the creditor. This term is sometimes, but improperly, applied to—

4. The *bond and disposition in security*, in which, in addition to the above, there is a conveyance of the lands themselves for the creditor's further security, together with a power of sale.

5. *Absolute disposition and back-bond* is a form of security in which the disposition of the lands to the creditor is absolute, qualified only by a personal obligation to restore them on payment of the debt.

6. *Ground-annual* is a form of security by which a perpetual annuity may be provided for. Ground-annuals are mainly employed in relation to house-property within burgh.

Adjudications and *inhibitions* are also of the nature of heritable securities.

HER'ITOR, in the law of Scotland, originally meant the proprietor of a heritable subject, but is now applied to such possessors of lands or houses as are liable in payment of parochial burdens, either for the support of parish schools, the maintenance of the poor, or the minister's stipend.

HERM (island). See GUERNSEY.

HER'MÆ, or more properly *Hermai*, were small statues made of a bust which passed into a square pillar instead of a human body. The bust of the god Hermes was so much the most common subject that his name was given to this variety of sculpture. A Hermes stood at the door of every Athenian house of consequence, by all the temples, at the corners of the streets, and in all the public squares, the height of life, but with only the head

properly finished, as described. From the centre of the front of the pillar protruded a phallus, indicating the sex of the statue. Where such an effigy stood the god himself was held to be present, and his genial worship was the most common religious act of Athens. The celebrated "mutilation of the Hermai," at the time of the sailing of Alcibiades for Sicily, is one of the puzzles of history. It certainly ruined Alcibiades, and by consequence Athens also. But though Alcibiades was accused of the crime, there is little doubt but that he had nothing to do with it, and it may have been the work of his enemies determined to destroy him. All the Hermai in Athens were broken about in one night by unknown hands, and the sacrilege was felt as a grave national calamity, involving certainly the anger of the god, and much calamity resulting therefrom. The Romans adopted the Hermes shape for the statues (called *Termini*) of their god Terminus, when they treated him with more respect than in the first ages, during which a stone or a post was held enough to mark his presence.

HER'MANN, no doubt the true name, or near it, of the *Arminius* of the Roman historians, was the son of Sigimer, chief of the Cherusci, and was born about 16 B.C. Having been sent in early youth as a hostage to Rome, he obtained the favour of Augustus, and was inscribed among the Roman knights. On his return to his native country he conceived the project of delivering it from the Romans. Varus, the Roman governor in Germany, had been acting with imprudent severity. Hermann found the materials ready to his hand, organized an insurrection, led Varus into an ambush, and totally annihilated his army, A.D. 9. He continued his efforts till the Romans had lost all their conquests beyond the Rhine. Germanicus undertook to retrieve the Roman honour, and began his operations with two campaigns, A.D. 14 and 15. After a series of successes on the part of the Romans, Hermann was called forth in A.D. 16 to meet the great Germanicus, and no doubt the former would have been vanquished had not the Emperor Tiberius in a mad fit of jealousy recalled his nephew. Germany remained after this practically unmolested. Hermann, as soon as the last Roman had disappeared, began with equal vigour to bring order into the warring tribes of Germany; but eventually he was killed by his own relatives, being accused, as it would seem, of aspiring to absolute dominion. He perished thus at the age of thirty-seven, in 21 A.D., after being for twelve years the leader and champion of Germany.

HERMAPH'RODITE, a being combining the two sexes in one body. The name comes from the Greek mythology, where the lovely son of Hermes and Aphrodite, who combined the beauty of both his parents, was beloved by the nymph of the fountain Salmacis at the foot of Mount Halicarnassus. Her passion not being returned, although he delighted in bathing in her fountain, she prayed the gods one day as she clung to him that they might be for ever united, and that with such earnestness that the gods granted her prayer. But since Hermaphroditus would not marry the nymph the decree was only to be executed by actually uniting the two bodies, and the poor nymph was absorbed into her lover's frame. Some very lovely and interesting statues exist among the antique, which endeavour to show the girl-boy as he lies by the fountain.

This curious idea of a double-sexed being seems to have fascinated men in many ages. Of course, until the present command of physiological research was attained, the thing in itself did not seem so impossible, and even now some physiologists point to remarkable facts showing that it is certainly within the realms of possibility that man in his very remote predecessors may have been a double-sexed or hermaphrodite animal. In all cases of alleged hermaphroditism actually occurring, it is found invariably that the sex is clearly declared (nearly always female), and any appearances to the contrary are merely superficial malformations.

The term has passed into botany and zoology. But while hermaphroditism is the normal condition in plants, the majority of flowers containing both male and female organs (or stamens and pistil), it is very exceptional in animals, even among the lowest forms. Thus oysters, loosely said to be hermaphrodite, are really either of one sex or of the other at any given time, but each individual becomes alternately male and female. As some animals alternate generations, so do oysters alternate sexes. But cestoid worms and earthworms, and some nematoids, as well as most leeches, are truly hermaphrodite, while snails and slugs contain organs of both sexes, so that two individuals are mutually male and female to each other.

HER'MAS, an early Christian writer and author of the treatise called "The Shepherd," which was very highly esteemed in the primitive church. Origen, Eusebius, and Jerome ascribe the work to the Hermas mentioned by St. Paul (Rom. xvi. 14), but the more probable opinion is that it was written by another Hermas, brother to Pius, bishop of Rome, who lived about the middle of the second century. By some of the churches "The Shepherd" was received as a canonical work, was bound up with the books of the New Testament, and publicly read in turn with them in the services. Most of the fathers speak of the book with respect, but it was decided to be apocryphal by a decree ascribed to Gelasius. The book is divided into three parts, the first being called the Visions, the second the Commands, and the third the Similitudes. It contains no direct quotations from any of the books of the Old or New Testament, and has but little positive dogmatic teaching, but it is valuable as a literary curiosity and for the light it throws upon Christian thought and feeling at that early period.

Originally written in Greek, it was until quite a recent period known only to European scholars from an ancient Latin version, and from some quotations found in the writings of the Greek fathers. A Greek text of very doubtful value was published in 1856 from a codex said to have been found at Mount Athos by M. Simonides, but a portion of the genuine Greek text was found in 1859 by Dr. Tischendorf in the Codex Sinaiticus. An Ethiopic version was published by Dr. H. Brockhaus in 1860 from a MS. discovered by M. Antonie d'Abbadie, an Abyssinian traveller and scholar. An English translation was published by Archbishop Wake in 1693, in his "Genuine Remains of the Apostolic Fathers," which has several times been reprinted.

HERMENEU'TICS, the science of interpretation, especially applied to the meaning of the Holy Scriptures. It differs from exegesis in that its true province is the discovery of the real meaning of the text, while the province of exegesis is the exposition of this meaning, and its application to the wants of mankind. The inquiries of hermeneutists are simply literary, dealing with the signification of words and idioms, the object and circumstances of writing, the credibility and character of the writer, and all that concerns the text and the interpretation of the Holy Scriptures. This branch of literature has received more attention of late than perhaps at any previous time; and although some (so-called) eminent critics of the present day have succeeded marvellously in "darkening counsel by words without knowledge," the result on the whole has been favourable to the elucidation of the text of Scripture.

HER'MES, an ancient Greek divinity, known to the Romans as *Mercurius* (Mercury), was, according to Hesiod ("Theog.," 942), the son of Zeus and Maia, the daughter of Atlas. The attributes of this deity are numerous, but it appears probable that he was originally considered to preside over flocks and herds.

In Homer the name of this deity is usually Hermeias. Kuhn has pointed out his identity with the ancient Hindu god Sarameya, in the Sanskrit Rig Veda, the dog-formed messenger of Yama. One of the epithets of Sarameya is "the spotted" (*carvara*), wherein we get the original of the Greek *Cerberus*, the dog-guardian of Hades. Thus the two chief offices of Hermes are clearly shown. As in the Vedas so in the Greek, Hermes is represented as the messenger of Zeus and the gods, and he conducts the souls of the departed to Hades. In later times he was regarded as the god of eloquence, or rather of persuasive speech-making; the inventor of the lyre and of weights and measures; the patron of merchants and of gain and wealth; and the protector of heralds, poets, musicians, and wrestlers. In fact Hermes was the god of clever shifty resource, extending even to cunning and actual roguery and thieving. Thieves were under his protection. The gods preferred him as their messenger in doubtful affairs needing diplomacy. He is naturally the god of dreams, those shifty perplexing visitations. Statues of Hermes, which were originally square blocks with a carved head upon them, were placed in the doorways of most private houses and temples at Athens. [See HERMÆ.] They were also erected where several roads met, to point out the way, and in the gymnasia.

Hermes is usually represented with a *chlamys* or cloak, a broad brimmed *petasus* or winged cap, *talaria* or winged sandals, and a *caduceus* or herald's wand, with two serpents twined about it, in his hand. These serpents were an after-corruption of the white ribbons which fluttered round the herald's staff. The winged sandals typified the wind, on which Hermes, as messenger of the gods, was fabled to ride. But though he "rode on the wings of the wind," a modern attempt to make him a wind-god is quite unjustifiable. The Egyptian god Thoth was also called Hermes by the Greeks.

HER'MES TRISMEGIS'TOS (Hermes the Thrice Greatest), a mythical personage assumed to be the Egyptian form of the god Hermes, and by the Platonists identified with the god Thoth. They called him *trismegistos* because to him they attributed the doctrine of the Word, the Logos; and in Egyptian hieroglyphics the word *great* is usually thrice repeated after his name. The Latin corruption *trismegistus* is still occasionally used. The epithet is not older in Greek than the second century. Many short works, of a religious and philosophical cast, written apparently early in our era, are attributed to him on account of the reverence attaching to his name. What we might call the genuine Hermetic books have perished. According to Clement of Alexandria there were forty-two of them, containing altogether a complete account of Egyptian priestly knowledge, science, art, and medicine, ceremonial hieroglyphics, other writing, &c. Iamblichus mentions 20,000 and Manetho 36,525, evidently an astronomical number with a mystic significance now lost. Some of the most ancient papyri, such as the "Book of the Dead," are thought to belong to it by many Egyptologists, and fragments have been preserved in several writers. They are none of them of high value as speculations. A translation by J. D. Chambers, with the odd title "Hermes Trismegistus, Christian Neoplatonist," was published in London in 1884. The Hermetic canon is believed to have been complete by the time of Pythagoras, indeed Pythagoras and Plato were said to have got from it the fundamentals of their teachings. Many of the sentences attributed to Hermes Trismegistos are really fine, such for example as the following:—"When shall I praise thee, O Father? For it is neither possible to comprehend thy hour nor thy time. Thou art the Mind that understandeth, the Father that maketh, the Good that worketh in all things. By me the truth praiseth the Truth, and good sings praise to the Good."

HERMET'ICS, another name for ALCHEMY, from HERMES TRISMEGISTOS, the mythical founder of the science. In traditional hermetics salt, sulphur, and mercury (hermes) were held to be the sole principles of the world, all substances else being formed by their combination in various forms. In Butler's "Hudibras," i. 2, the word occurs in another sense:—

> "A pouch he wore,
> Replete with strange hermetic powder,
> That wounds nine miles point-blank would solder."

The hermetic powder here spoken of was the "powder of life" alleged to exist by the alchemists or hermetics, which could cure diseases at whatever distance from the sufferers the physician might be. As the alembics, &c., were carefully luted and closed to prevent evaporation during alchemical or hermetical distillations, such careful closure has received the name hermetical, and anything perfectly air-tight and water-tight is said to be *hermetically sealed*. The *Hermetic Books* are those curious Greek books alleged to be translations of the mythical Hermes Trismegistos, of unknown date and authorship, containing very ancient and early Christian writings mixed confusedly, and setting forth crude notions side by side with elevated Neoplatonic ideas.

HER'MIT, more properly *Eremite* (from the Greek, *eremites*, signifying an inhabitant of the desert), is the name given to such religious persons as retired from society without becoming members of any monastic community. The name hermitage is given to the solitary cell or habitation of a hermit, or sometimes the term is used to denote the dwelling-places of a community of hermits. These have often exercised considerable influence on the surrounding districts, and frequently laid the foundation of towns, cities, and ecclesiastical establishments.

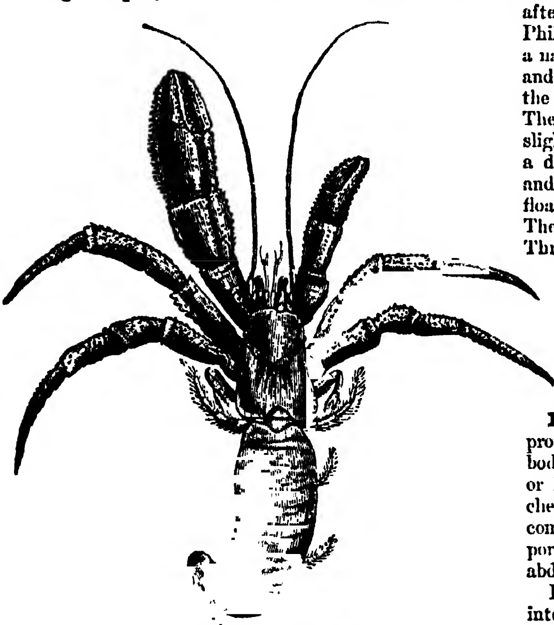
HER'MIT (Phaëthornis) is a genus of HUMMING-BIRDS (Trochilidæ). This genus contains numerous species, most of them remarkable for elegance of form, though none of them exhibit those brilliant metallic tints with which many other humming-birds are adorned. The Cayenne Hermit (*Phaëthornis superciliosus*), one of the commonest and best known of the humming-birds, is abundant in Guiana, and also occurs in the northern provinces of Brazil. It measures rather more than 7 inches in length, including the very long bill, which is about 1⅝ inch, and the two elongated middle tail feathers, which project nearly an inch beyond the rest of the tail. The latter character is common to nearly all the species of the genus Phaëthornis. This bird is of a bronzed brown colour on the upper surface, with a buff superciliary streak; there is also a buff streak beneath the eye; the lower surface is of a dusky fawn colour, passing to buff on the lower tail-coverts; the quill feathers of the wings are purplish-brown, and those of the tail bronzed green, becoming blackish towards the tip, where the lateral feathers are terminated by an arrow-shaped buff mark; the prolonged apical portion of the two middle feathers is white. The upper mandible is black, and the lower one reddish, with the tip black.

The Little Hermit (*Phaëthornis eremita*), a small species about 4 inches in length, is of a reddish-buff colour, with the head, neck, and back bronze-green, the wings deep purplish-brown, and the tail feathers bronze-brown, tinged with green, and tipped with deep buff; across the breast there is a black crescent-shaped mark. This species is found in Southern Brazil, where it appears to be abundant. Its nest is composed of various fine vegetable fibres held together by spider's web; it is in the form of a round deep cup, tapering into a long point at the bottom. It is ingeniously attached by means of cobweb to the extremity of a leaf, forming a most elegant cradle for the two young birds, which are hatched from the delicate pink-white eggs. Mr. Wallace remarks that he has never seen *Phaëthornis eremita* and some larger allied species at flowers. "These inhabit the gloomy forest shades, where they dart about among the foliage; and I have distinctly observed them

visit in rapid succession every leaf or branch, balancing themselves vertically in the air, passing their beaks closely over the under surface of each leaf, and thus capturing, no doubt, any small insects that may be upon them. While doing this, the two long feathers of the tail have a vibrating motion, apparently serving as a rudder to assist them in performing the delicate operation."

Other species of hermits construct beautiful pensile nests. The exterior of the nest of the Pigmy Hermit (*Phaëthornis pygmæus*) is covered with seeds of a downy nature, while the interior is lined with similar down and the delicate fibres of plants.

HER'MIT-CRAB is the popular name given to species of Paguridæ, a family of crustaceans belonging to the order Decapoda, forming the type of a section of that order, Anomura, the irregularly-tailed Decapoda. The hermit-crabs are remarkable for the more or less complete softness of the abdomen, and the want of symmetry in the appendages of that part of the body. In the greater number the abdomen is small, nearly entirely membranous, and partially rolled upon itself; and for the protection of this defenceless part the animal generally lodges it in the turbinated shell of some gasteropod, such as a whelk. The crab is retained



Common Hermit-crab (*Pagurus bernhardus*).

in the shell by the aid of the posterior feet and a pair of appendages at the end of the abdomen. In some species it is further fixed by means of suckers on the lower side of the abdomen. These crabs are held so firmly in the shell of which they have possessed themselves, that they move about with it more or less briskly according to its comparative size or aptitude. The hermit-crab or soldier crab, as it is sometimes called, forms an effective operculum to his shell by means of his large nippers (*chelæ*) and the tips of the two succeeding pair of appendages; one of the chelæ is bigger than the other. As the crab grows in size it is obliged to change its lodging and seek some larger shell.

The hermit-crabs are all more or less terrestrial in their habits, and some are found at a considerable distance from the sea. A tropical species (*Cenobita brunnea*) is often found comfortably ensconced in an empty nut-shell. The TREE-CRAB (*Birgus latro*) lives on cocoa-nuts, in search of which it is said to climb trees. The common hermit-crab of English coasts is *Pagurus bernhardus;* this species inhabits almost every whorled shell, such as whelks, periwinkles, &c., feeding chiefly on molluscs.

HERMO'GENES was a native of Tarsus, and lived under Marcus Aurelius. At the age of fifteen, it is said, he was professor of Greek eloquence at Rome, where his lectures were attended by that emperor. At the age of eighteen he wrote his work on the oratorical art, consisting of four sections. His illustrations and quotations are chiefly taken from the "Orations" of Demosthenes. He fell ill at the very youthful age of twenty-five, and quite lost the use of his mind. The maturity of the work done before his mind gave way is astonishing. The work of Hermogenes was held in high esteem, and became a standard book in all Greek schools. It has been repeatedly printed in the Greek text, and Gaspard Laurent published it with a Latin translation and commentaries (8vo, Geneva, 1614). The best edition is in the collection of Walz, "Rhetores Græci" (Stuttgart, 1826), which contains also the oratorical exercises of the author called "Progymnasmata."

HERNAN'DIA is a genus of plants, placed by Bentham and Hooker in the order LAURINEÆ. It was named after Hernandez, a naturalist who was sent out to Mexico by Philip II. of Spain. *Hernandia sonora* is a tall erect tree, a native of the various parts of the East and West Indies, and has obtained its name *sonora* from the noise made by the wind in whistling through its persistent involucels. The bark, the seed, and the young leaves of this tree are slightly cathartic. The juice of the leaves is employed as a depilatory. It destroys the hair wherever it is applied, and this without producing pain. The wood is used for floats, and takes fire with flint and steel like tinder. There are eight species in the genus, natives of the tropics. Three flowers are inclosed in an involucre, the central one being only pistillate, the other two having stamens, but no pistil. The anthers are two-celled, dehiscing laterally. The female flower is surrounded at the base by a cup-shaped involucel, which increases so as to inclose the fruit; and the ovary is inferior. The species are trees with large leaves, cordate and peltate.

HER'NIA (from Gr. *ernos*, a branch) signifies the protrusion of any organ from its natural position in the body, as *hernia cerebri*, *hernia pulmonis*, when the brain or lung protrudes through an aperture in the skull or the chest. But when used alone this term means what is commonly called a *rupture*, that is, the protrusion of any portion of the intestinal canal from the cavity of the abdomen.

Herniæ sometimes form without any evident cause, the intestine being gradually protruded; but more frequently they result from some violent bodily exertion, as lifting heavy weights, excessive coughing or straining; or from sudden jarrings or shocks, as in jumping or falling; or from blows on the abdomen. Navel rupture in young children is sometimes caused by the improper management of the navel string, or it may arise as a consequence of prolonged crying.

Several forms of hernia are distinguished by surgeons according to the part of the abdomen through which the bowel protrudes, such as the inguinal, femoral, and umbilical herniæ, and they are further divided into (1) *reducible*, *i.e.*, such as can be returned into the abdomen; (2) *irreducible*, where the protrusion is permanent; and (3) *strangulated.*

The general characters distinguishing a reducible hernia are—a tumour, neither red nor hot, and often not painful, situated at some part of the abdomen, most frequently in or near the groin; largest when the patient stands up, and often disappearing entirely when he lies down; distended by coughing or other violent expiration, and liable to

variation in size by exercise or rest, by abstinence or taking food; often producing disorders of the digestive canal, as flatulency, colic, &c. In the cases in which the hernia forms suddenly, as in consequence of a great exertion, the patient feels as if something had given way at the groin or other part of the abdomen, and on putting his hand there he feels a tumour, which may vary in size from that of a nut to that of his fist, is elastic, hard, and tense, and soon after the accident becomes painful and tender. In the other class of herniæ the tumour forms almost imperceptibly to the patient, and grows larger regularly but slowly. If a hernia can be returned into the abdomen at pleasure, it is not by itself a dangerous disease; but there is always the danger of its becoming irreducible, and thus a permanent source of discomfort, or strangulated, involving possibly fatal consequences. Whatever be the situation of a hernia it should at once, if possible, be reduced. The patient should go to bed, and after lying for a time on the back with the knees raised the intestine will often of itself recede into the abdomen, especially if it has been frequently protruded. If it does not return it may often be worked into its place by means of the hands. The treatment of all reducible kinds of hernia consists in the use of means designed to prevent the escape of the protrusions. This is usually effected by means of a peculiar bandage, called a truss, which is essentially a pad at the end of a spring, the spring passing round the body, and so arranged that the end carrying the pad shall press upon the part affected. The great prevalence of hernia has led to the fabrication of an immense variety of trusses, and nearly every form of the disease can be provided for by a skilled surgical instrument maker. Before a truss is applied the hernia must be reduced, and when the truss is put on it should be worn all day at least, and if it, or a lighter form, can be worn during the night it will be an advantage. In the case of children and young persons hernia is commonly curable, though the truss may have to be worn for a long period, sometimes two or three years. The navel rupture of infants is treated by means of a simple pad, such as a slice of wine cork covered with soft linen, which is kept in place by strips of plaster and a bandage, or a Burgundy pitch plaster with a pad of the same material may be placed over the part affected.

Irreducible hernia is also treated by the employment of a truss, but instead of a pad to press upon the place a hollow bandage to inclose the protrusion is required, and this must must be shaped and designed according to each individual case. Sometimes when an ordinarily reducible hernia becomes irreducible through constriction caused by contraction of the muscular tissues, a relaxation of the latter may be produced by means of chloroform, and the hernia can then be returned. Where such a hernia is rendered irreducible through the accumulation of feculent matter, aperient medicines or enemata may afford relief.

The most serious form of hernia is that which is termed strangulated, that is, where the intestine is so constricted by the parts through which it has passed that its contents cannot pass through it, and its vessels are so much compressed that active inflammation is excited. It constitutes one of the most serious accidents to which the human body is liable. The symptoms indicating strangulation of the intestine are obstinate constipation of the bowels; pain and tenderness of the tumour, spreading from it over the whole surface of the abdomen; extreme restlessness and languor; nausea and vomiting; a hard, small, and rapid pulse; thirst and coldness of the limbs. If the hernia be not reduced, these symptoms will regularly increase till mortification of the intestine ensues, and (except in some most rare cases) death rapidly follows.

Very often the first sign of strangulated hernia is that of bilious vomiting, and where this follows any severe strain or the appearance of a lump on the groin or abdomen surgical advice should be at once sought. The means adopted for relieving this condition consist in the use of a peculiar form of manipulation known as the taxis; in the administration of chloroform, the use of bleeding or of the hot bath to produce relaxing of the muscles, the local application of ice, and lastly the liberation of the bowel by means of the knife. It is very often necessary that recourse to an operation should be made at the outset, for every minute adds to the danger of the patient, and if the operation be delayed it may be too late to save life, even though the bowel be successfully returned to the abdomen.

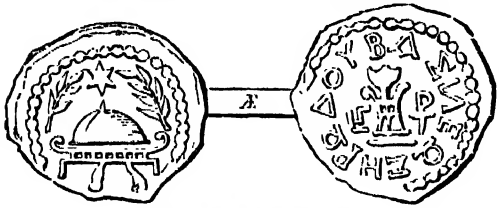
HERO (mathematician). See HERON.

HERO and **LEANDER**, a graceful pathetic pair of figures in Greek legend. Hero was a priestess of Aphrodite in Sestos, one of the towns in the Troad or plain of Troy, by the shores of the Hellespont. She was seen at a festival and loved by a Thracian youth, Leander (*Leandros*), dwelling at Abydos, on the European shore, a little higher up the stream than Sestos. Their union being impossible, since Hero's parents forbade her quitting the priesthood, Leander took the course of visiting his beloved nightly, swimming across the Hellespont, and swimming back again before morning. The beacon light of Sestos was his goal in the darkness; some say Hero herself placed the lamp there nightly. Once during a fearful storm the lamp was extinguished, and Leander, left without a guide, perished in the waves. His body was thrown ashore at Sestos, and Hero recognizing it threw herself down from the beacon tower into the sea. The ancients were very fond of the legend; Ovid, Statius, and Virgil all use it, and Musæus, or rather the later poet who adopted his name, made it the subject of an epic. Schiller has a fine poem on the subject in his very best style. Our fine Elizabethan writers loved the tale well. Chapman and Marlowe narrated it in their own picturesque and vigorous English, the English of Shakspeare and the Great Bible. The Hellespont between Sestos and Abydos is about a mile wide, running with a very strong southerly current. To cross it is highly dangerous, but not beyond the strength of a good swimmer. It will be remembered that Lord Byron performed the feat.

HER'OD (*Herodes*), the name of a family of Idumean origin and Jewish faith, which flourished during the period immediately preceding the final destruction of the Jewish nation. Of this family the most important members were the following:—

I. HEROD THE GREAT, the second son of Antipater, who had been appointed procurator of Judea by Julius Cæsar, 47 B.C. At the time of his father's elevation Herod was fifteen years old, and he was appointed governor of Galilee, where after strenuous efforts he succeeded in destroying the bands of robbers by which that country was infested. In the year 41 B.C. Herod and his elder brother Phasel were appointed joint-tetrarchs of Judea, but the invasion of the Parthians in 40 B.C. caused him to flee to Rome, where he received the appointment of King of Judea and the promise of aid from the Roman generals in Syria for the recovery of his kingdom. This promise was fulfilled, but it was not until the end of the year 38 B.C. that Jerusalem was taken, after a siege of six months, and his authority became established. During the siege he married Mariamne, the granddaughter of Hyrcanus, and when he became seated upon the throne he made her brother Aristobulus high priest. In the war between Octavianus (afterwards the Emperor Augustus) and Antony Herod assisted the latter, but after his defeat he went to meet Octavianus at Rhodes, and was by him confirmed in his kingdom, 31 B.C., and subsequently he received from Octavianus the governorship of all Syria and some large additions to his territorial possessions. The remainder of his reign was undisturbed by foreign interference, and his extraordinary energy, strong will, and the magnificence of his public administration raised the country to a position of considerable influence, and earned for him the title of Great. He restored and

enlarged the temple in a magnificent manner, erected an amphitheatre outside Jerusalem, where games in honour of Cæsar were held every five years, adorned the principal cities with grand and costly buildings, and executed large and important public works. But in order to do this he was compelled to impose heavy taxation upon his subjects, whose dislike was intensified by his love for foreign customs and his disregard of their law. Again and again their discontent made itself manifest, but only to be suppressed by unrelenting severity. He was more than once cited to Rome, but by his extraordinary gifts of diplomacy, amounting to fascination, and by lavish gifts he always returned stronger than he went. In his domestic life he was dominated by suspicion and jealousy, and under those influences there was no cruelty too great for his perpetration. His wife Mariamne, whom he almost worshipped,

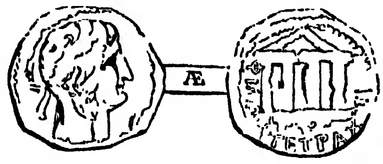


Coin of Herod the Great.

and the loss of whom drove him mad for a time, her brother Aristobulus, whom he had made high priest, his wife's mother Alexandra, and his own sons Aristobulus, Alexander, and Antipater—all fell victims to his tyranny, though it is probable his fears of treason and assassination were not wholly groundless. He died of a loathsome disease, during the progress of which he had raged like a demon, in March, 4 B.C., in the thirty-fourth year of his reign. At his death his dominions were divided between his sons. The birth of Jesus Christ took place during the last year of his reign, four years earlier than the era from which the common chronology dates the years A.D.

II. Herod Antipas was the son of Herod the Great by a Samaritan woman, Malthacê, and by his father's will he was appointed tetrarch of Galilee and Petræa. He was first married to a daughter of Aretas, king of Arabia Petræa, but about the year 26 A.D. he deserted her for Herodias, the wife of his half-brother, Herod Philip. Herodias was niece as well as wife to these Herods, for she was the granddaughter of Herod the Great and Mariamne. The prophet John the Baptist having remonstrated against this marriage was imprisoned and afterwards put to death, and soon afterwards Aretas invaded his territory and defeated the troops of Herod with great loss. On the accession of Caligula, A.D. 37, he was induced by Herodias to go to Rome and seek the title of king which had been given to his father and his nephew Agrippa I., but instead of obtaining his request he was deprived of his dominions and banished to Lugdunum (Lyons), where he was joined by Herodias, A.D. 39. He was afterwards removed to Spain and died in obscurity. It was this Herod to whom Christ was sent by Pilate, Herod being at the time on a visit to Jerusalem. His chief public work was the founding of the city of Tiberias in honour of the emperor.

III. Herod Philip, son of Herod the Great by his wife Cleopatra, tetrarch of Ituræa, &c., from Herod's death, was not the husband of Herodias, as is sometimes thought. Augustus confirmed him in his dominions, and he reigned from B.C. 4 to A.D. 34, governing his people with fairness and moderation. He founded the city of Cæsarea Philippi (near the Jordan), which he named in this way in honour of his constant patron the Emperor Augustus Cæsar. When the evangelists speak of Herod (Antipas) taking "Herodias, his brother Philip's wife," the brother meant is Herod Philip, son of Herod the Great by his favourite wife Mariamne. Aristobulus, the brother of this Herod Philip (full-brother, son of the same mother), was father of the notorious Herodias. She was therefore her



Coin of Herod Philip, the Tetrarch.

husband's niece, and ran away from the arms of her full-uncle to those of her half-uncle Antipas. Her daughter (Salomê) was by Philip.

IV. Herod Agrippa I., son of Aristobulus, brother of the infamous Herodias, and grandson of Herod the Great and Mariamne, after experiencing many vicissitudes in early life, was appointed, upon the accession of Caligula, in 37 A.D., king of the dominions formerly held by Herod Philip, namely, Gaulanitis, Batanæa, and Trachonitis, to which Caligula added the tetrarchy of Lysanias; and afterwards, when Antipas was banished, the tetrarchy of Galilee and Peræa. Claudius added Judæa and Samaria to his dominions A.D. 41. His government was popular with the Jews, to please whom he persecuted the Christians (Acts xii. 1–3). He died of a loathsome disease at Cæsarea, in the fourth year of his reign over all Palestine, A.D. 44 (Acts xii. 20–23.)

V. Herod Agrippa II., son of the above, was seventeen years of age at the time of his father's death. Upon the death of Herod, king of Chalcis, four years afterwards, Claudius bestowed that kingdom upon Agrippa. He did not leave Rome till A.D. 53, when Claudius gave him his father's old tetrarchies of Gaulanitis, Batanæa, and Trachonitis. His dominions were enlarged by Nero. It was in A.D. 60 that the trial of Paul before Agrippa took place (Acts xxvi.) Agrippa exerted himself to keep down the spirit of revolt among the Jews. When war broke out Agrippa joined the Romans. After the taking of Jerusalem, he retired with his sister Berenicê to Rome, where he died at the age of about seventy years.

HERO'DES, TIBE'RIUS CLAU'DIUS ATTICUS, a native of Marathon, in Attica, and of an illustrious family, was born under the reign of Trajan. He inherited from his father a very large property. Herodes was educated by the best teachers of his time, and he became an accomplished scholar, rhetorician, and philosopher. Having removed to Rome, his wealth, his connections, and his extemporary eloquence, which is spoken of as wonderful, gave him great importance, and he was made consul with C. Bellicius Torquatus in 143. The Emperor Marcus Aurelius and his colleague Verus were his pupils as youths. Herodes died at Marathon, in the seventy-sixth year of his age, towards the end of the reign of Aurelius or the beginning of that of Commodus. He erected monuments, temples, baths, and aqueducts in Italy, Greece, and Asia. Pausanias (vii. 20) mentions an odeion, or music theatre, at Athens, as built by him, called the Theatre of Regilla, after his wife, a Roman lady of noble family; he also embellished the stadium near the Ilissos, which was originally constructed by the orator Lycurgus, 350 B.C.

HERO'DIAN (*Hêrôdianos*) was the name of two celebrated Greek writers. The first (Ælios Herodianos), an Alexandrian, the son of the grammarian Apollonios Duskolos (the Ill-tempered), was held the first grammarian of antiquity, but is only known to us through quotations from his works. He came to Rome and lived high in the favour of the Emperor Marcus Aurelius, who himself wrote his famous "Inner-self" or *Meditations* (*ta eis heauton*)

in Greek, as the literary language of the time. His work on prosody, which was regarded as the authority on the subject, was dedicated to the emperor at his request. The second Herodian is known to us by the happy preservation of his work, but of his personal existence we know nothing. He lived about half a century later than Ælios Herodianos, and wrote a history of Rome from the death of Marcus Aurelius (180) to the accession of Gordian III. in 238, which is very impartial, and therefore extremely valuable, as well as being very readable from a literary point of view.

HERO'DIANS (Matt. xxii. 16; Mark iii. 6; xii. 13; see also Mark viii. 15) were in all probability a political party in Judæa who were anxious to preserve the government in the hands of Herod's family. Many critics consider the Herodians to have been a religious sect. In their religious opinions they probably belonged to the sect of the Sadducees, since that which is called by Mark (viii. 15) "the leaven of Herod" is styled by Matthew (xvi. 6) "the leaven of the Sadducees."

HEROD'OTUS (*Herodotos*), a native of Halicarnassus, a Dorian city in Caria, was born about B.C. 484. If the passages in his own history (i. 130; iii. 15) were written by himself, he was probably alive in B.C. 408. He was the son of Lyxus and Dryo, and of an illustrious family in his native state. Not liking the government of Lygdamis, who was tyrant of Halicarnassus, he retired for a time to Samos, where he is said to have cultivated the Ionic dialect of the Greek, which was the language of that island. Before he was thirty years of age he joined in an attempt, which proved successful, to expel Lygdamis. Herodotus again left his native country, and joined, as it is said, a colony which the Athenians sent to Thurii, in South Italy (B.C. 443). He is said to have died at Thurii, and to have been buried in the Agora or Public Place. Herodotus was a traveller and observer as well as an historian. The extent of his travels may be ascertained pretty clearly from his history. Lucian's story of his reading his work at the Olympic games, which has found its way into most modern narratives, has been well discussed, and we may perhaps say disproved, by Dahlmann ("Aus seinem Buche sein Leben," Altona, 1830).

Herodotus makes no display of the great extent of his travels. He frequently does not say that he was at a place, but he uses words which are as conclusive as any statement. He describes a thing as standing behind the door (ii. 182), or on the right hand as you enter a temple (i. 51), or he was told something by a person in a particular place (ii. 28), or he uses other words equally significant. In Africa he visited Egypt, from the coast of the Mediterranean to Elephantine, the southern extremity of the country (ii. 29), and he travelled westward at least as far as Cyrene (ii. 32, 181). In Asia he visited Tyre, Babylon, Ecbatana (i. 98), and probably Susa (v. 52–54; vi. 119). He also visited various parts of Asia Minor, and probably went as far as Colchis (ii. 104). In Europe he visited a large part of the country along the Black Sea, between the mouths of the Danube and the Crimea, and went some distance into the interior. He seems to have examined the line of the march of Xerxes from the Hellespont into Attica, and certainly had seen numerous places on this route. He was well acquainted with Athens (i. 98; v. 77, &c.), Delphi, Dodona, Olympia (ix. 81), Tegea (i. 66), Thasos, Delos, Zakynthos (iv. 195), and numerous other places in Greece. That he had visited some parts of South Italy is clear from his work (iv. 99; v. 44, 45). The mention of these places is sufficient to show that he must have seen many more.

The Nine Books of Herodotus contain a great variety of matter, the unity of which is not perceived till the whole work has been thoroughly examined. But the subject of his history was conceived by the author both clearly and comprehensively. "The object of the inquiries (for so we may render the word *historiæ*) of Herodotus of Halicarnassus is this, that the acts of man may not be forgotten through lapse of time, and that great and wondrous achievements, performed partly by Greeks and partly by Barbarians, may not be without their fame; and also how it came to pass that Greeks and Barbarians waged war together" (i. 1). His object, then, was to combine a general history of the Greeks and the Barbarians (that is, those not Greeks) with the history of the wars of the Greeks and the Persians. Accordingly, in execution of his main subject, he traces the course of events from the time when the Lydian kingdom of Crœsus fell before the arms (B.C. 546) of Cyrus, the founder of the Persian monarchy, to the capture of Sestos (B.C. 478), an event which crowned the triumph of the Greeks over the Persians.

The great subject of his work, which is comprised within the space of sixty-eight years, not more than the ordinary term of human life, advances with a regular progress and truly dramatic development, from the first weak and divided efforts of the Greeks to resist Asiatic numbers to their union as a nation, and their final triumph in the memorable fights of Thermopylæ, Salamis, and Platæa. But with this subject, which has a complete unity well maintained from its commencement to its close, the author has interwoven, conformably to his general purpose, and by way of occasional digression, sketches of the various peoples and countries that he had visited in his widely extended travels. His predecessors in historical composition appear generally to have chosen subjects of a limited nature, partaking chiefly of the character of local annals. Herodotus chose for his subject a series of events which concerned the universal Greek nation, and not them only, but the whole civilized world; and by the way in which he executed his great undertaking he has earned the honourable and well-merited appellation of the Father of History.

The style of Herodotus is simple, pleasing, and generally perspicuous, often highly poetical both in expression and in sentiment. But it bears evident marks of belonging to a period when prose composition had not yet become a subject of art. His sentences are often ill-constructed and hang loosely together; but his clear comprehension of his own meaning, and the sterling worth of his matter, have saved him from the reproach of diffuseness and incoherence. His accuracy, when he speaks of his own knowledge, is astonishing, and is perpetually being tested, even in our own day; but he sometimes shows himself over-credulous in repeating tales of others. There is no translation of Herodotus which has yet done justice to the original; and no commentary has yet exhausted one-tenth of the matter which admits and requires illustration.

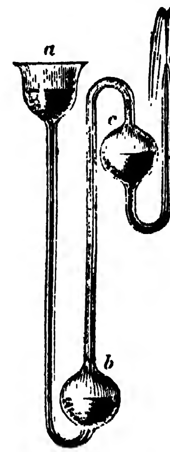
The first edition of Herodotus was the Latin translation of L. Valla (Venice, 1474, folio). "The Apology of Herodotus," by H. Stephens, prefixed to his corrected edition of Valla's translation (Frankfurt, 1595), is a clever and amusing vindication of Herodotus against the charge of falsehood, made on the ground that many of his stories were so singular and improbable. L'Archer's French translation (Paris, nine vols. 8vo), with the Commentary, is a useful book. Schweighauser's edition of 1816 (Strasburg, six vols. 8vo), previously by far the best Greek text, was superseded a few years back by the work of Stein, which latter is now outshown by the superb edition of Professor Sayce, the first three volumes of which appeared, with copious notes and appendices, at Oxford in 1883. Professor Sayce having visited all the countries spoken of, except Babylonia and Persia, criticises Herodotus authoritatively, while his large Egyptian knowledge throws light on the most obscure passages of the old Greek. Professor Sayce is, however, a profound disbeliever in the ordinary view of Herodotus as accurate and honest except where misled. He shows that Herodotus certainly hints at having

personally seen things he never had visited, and accuses him of affecting to be acquainted with languages of which he knew not a word. Further, it is alleged that he pilfered without acknowledgment from Hecatæus and other authors, and, while pilfering, sought to throw discredit and ridicule upon those whose pages he plundered. Herodotus seems as if he had seen Thebes and Karnak, and sailed up the Nile as far as the first cataract. Professor Sayce proves that he can never have ascended higher than Faioum. Herodotus is believed by his readers to have mused among the ruins of Nineveh, admired the Babylonian temple of Bel, and gathered with his own hand that millet and sesame which grew so luxuriantly that he would not tell its height, "lest it should seem incredible to those who have never visited the country!" (Book I., chap. cxiii.) Yet Professor Sayce shows that he can never have crossed the Gyndes, that his narrative allows for no intermediate territory between the Euphrates and the Tigris, and that the temple of Bel was destroyed by Xerxes some forty or fifty years before the date of his imaginary visit. But nothing can destroy the charm of this incomparable story-teller; and even when compelled to admit some of the charges of Professor Sayce, readers of Herodotus will probably find a loophole to save their favourite.

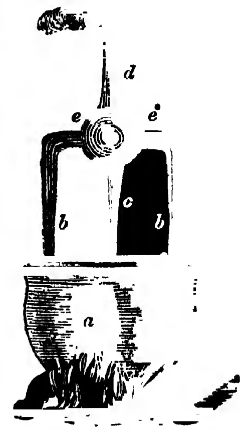
HÉROLD, LOUIS JOSEPH FERDINAND, a distinguished French musician, the son of a clever pianist of the classical school, was born in Paris in 1791, and died there in 1833. He is known by his excellent opera of "Zampa," which only does not keep the stage because of its feeble libretto, but the music of which is still high in popular favour, especially the bright and effective overture (a prime favourite with all classes of musicians), and his still better opera of "Le Pré aux Clercs," one of the most admired French dramatic musical works we possess, continually in demand for representation, and still enjoying undiminished popularity. Hérold was educated musically at the Conservatoire of Paris, which he entered in 1806, obtaining the grand prize of Rome in 1812. His Roman works are chiefly instrumental, his long series of operas not beginning till his return to Paris. His first essay in this branch of composition was in collaboration with Boieldieu on "Charles de France." None of Hérold's operas but the two mentioned now survive, in England at least; the dates of these were "Zampa," 1831, and "Le Pré aux Clercs," 1832. Closing his career with two such masterpieces, his death seems especially regrettable.

HE'RON (sometimes called in English *Hero*). There are two of this name, both writers on mathematical and mechanical subjects. Heron the Elder was the pupil of Ktesibios (Ctesibius), and lived at Alexandria about B.C. 250. The country of the younger and less famous Heron is uncertain, but he is supposed to have flourished about 630, under the Emperor Heraclius.

Heron the Elder must have enjoyed great reputation since he is mentioned by Gregory Nazianzen with Euclid and Ptolemy; but he is now principally known by large fragments of his writings on mechanics, which are to be found in the "Mathematici Veteres" (Paris, 1693). He was certainly a most remarkable man, and it is probable that some things have been attributed to him which were due to others. Among these is the "hydraulic" organ, that is, an organ blown by means of the pressure of water upon a confined body of air [see ORGAN, HYDRAULIC], which he himself very properly attributes to his master Ktesibios. So clearly is this described in the "Spiritalia," that models of instruments have been constructed on this plan which work perfectly. Another contrivance of Heron's is the well-known fountain which bears his name, and of the principle of which an illustration is subjoined. Water descending from the cup *a* by its own weight compresses the air in the partly empty globe *b*, and hence in the globe *c* also, driving the water contained in the globe *c* out at the jet *d*. A still more elegant arrangement is one when the globes *b* and *c* are placed directly in a vertical line, and the jet rises in a basin above them. In this case it is the water in the upper globe whose weight descending compresses the air in the lower globe, and so sets the jet in action. But the contrivance for which Heron is most generally admired is the æolipile, a sketch of which is also given. From a closed vessel, *a*, containing water heated by a fire beneath it, steam rises through the pipes *b b*, which pierce the cover. These pipes end above



Heron's Fountain.



The Æolipile.

in conical points, and being bent horizontally and inwards towards each other near their top, at *e e*, they serve as supports to a hollow ball. The steam then passes through the perforations at the end of the pipes into this ball. The ball has two arms, *c* and *d*, and near the extremity of each arm is a little hole, the hole in the arm *d* being towards the observer, and that in the arm *c* away from the observer. The jets of steam therefore escape from these holes, and striking the air force the ball to rotate, the arm *d* being pushed downwards and away from the observer, and the arm *c* upwards and towards the observer. The machine will rapidly rotate in a direction away from the observer, "as if it were animated from within by a living spirit." Heron had, it will be observed, here discovered and turned to account the elasticity of steam.

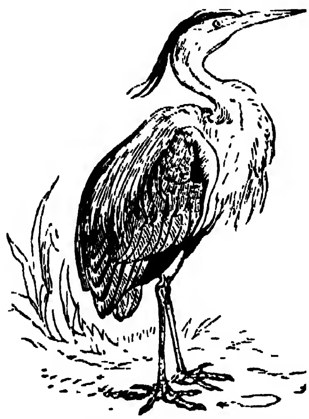
HER'ON is the name of the well-known wading bird which is the type of the family Ardeidæ, belonging to the order GRALLÆ. In the family Ardeidæ the bill is long, stout at the base, and sharp pointed. The internal edge of the middle toe is pectinated, and the claw of the hind toe very large. The tarsi are very long, scutellated in front, and reticulated posteriorly. The neck is elongated. The wings are very long, and the birds, though not very rapid in their movements, are generally endowed with considerable powers of flight. The stomach is capacious, and capable of considerable distension. The food of these birds consists of fish, reptiles, and such small mammalia as shrews, water-rats, &c. Some are gregarious during the breeding season, and build in lofty trees; others are altogether solitary. All are recluse, frequenting wide marshes and the banks of rivers, which supply them with food. These birds are found in all the warmer and temperate parts of the world.

As examples we may mention the Common Heron (*Ardea cinerea*), the Crested Purple Heron (*Ardea purpurea*), the Great Egret (*Ardea alba*), the Little Egret (*Ardea garzetta*), the Little Bittern (*Ardea minuta*), the Squacco Heron (*Ardea ralloides*), the Bittern (*Botaurus

stellaris), and the Night-heron (*Nycticorax griseus*), all claiming to be regarded as British birds, though some are only occasional visitors and do not breed in this country.

The Common or Gray Heron (*Ardea cinerea*) is tolerably common in England. It is a large species, measuring fully 3 feet in length, and is furnished with enormous wings, which, when spread, look quite disproportionate to the size of the bird. The general colour of the plumage is bluish-gray above and white beneath. The back of the head is adorned with a crest of long dark slate-coloured feathers; the bill is yellow and the legs greenish.

The common heron appears to be generally distributed over the Old World, but in its most northern haunts is found to be migratory, only visiting them in the summer. At this season the bird frequents inland districts, along the margins of lakes and rivers, in the neighbourhood of marshy places; but in the winter it frequently resorts to the shores of the sea and the mouths of rivers. Its food consists principally of fishes, which it captures by standing patiently in the water until they pass within its reach, when the long neck is immediately darted out, and the



Common or Gray Heron (*Ardea cinerea*).

luckless prey is generally secured and swallowed. When fish are not plentiful the heron feeds on frogs, mice and rats, aquatic insects, earthworms, &c. At the commencement of the breeding season the herons become very sociable in their habits, and congregate in some wood or clump of large trees, the same position being generally occupied by them for many years in succession. By the reclaiming of marsh ground many of the large heronries in England have been broken up. It is estimated that there are at the present time about 100 heronries in England and Wales, fifty in Scotland, and fifty in Ireland. The broad flat nest is generally built in the top of some lofty tree; it is composed of sticks and twigs, and lined with wool and dry grass. The eggs are four or five in number, and of a sea-green colour.

In the days of falconry the heron was greatly valued, and the destruction of its eggs was visited with a penalty of 20*s.*; moreover, it held as high a place at the tables of the great as it did in the field. Its flesh is now disregarded, being considered fishy; the nestlings are said to be very palatable. For other species of the heron family see EGRET, BITTERN, NIGHT-HERON, BOATBILL.

HEROS'TRATOS was an Ephesian who set fire to the great temple of Artemis at Ephesus, B.C. 356, it is supposed, on the night of the birth of Alexander the Great. He was discovered readily—indeed he courted discovery—but as no reason could be given for his act he was put to the torture. He confessed under this that he had merely desired to gain immortality for his name by so great a crime, for the temple was one of the wonders of the world. The Ephesians put him to death, as he deserved, and to defeat his object passed a stringent decree that no one should ever mention his name; in consequence of which it has come down to posterity, and no year passes without its being quoted.

HER'PES, the name given to certain well-defined eruptions of the skin characterized by the appearance of clusters of globular vesicles, situated on a red and inflamed base extending some lines beyond them. The vesicles of each cluster commonly vary in size from a millet seed to that of a small pea, and the patches in which they occur from spots about an inch in diameter to blotches of 4 or 5 inches. The vesicles contain at first a transparent fluid, which afterwards becomes thick and purulent, and they finally terminate in a dark-coloured scab firmly embedded in the skin, which in falling off frequently leaves a scar. The eruption is preceded and accompanied by a burning pricking sensation, and sometimes by severe neuralgic pains. The clusters of vesicles sometimes occur singly, at other times they may range from five to ten in number, and in their situation on the body they follow the course of the distribution of the nerves.

In the most strongly marked form of this disease, *herpes zoster* or *zona*, familiarly known by the name of shingles, there is a succession of clusters of white silvery vesicles, forming an oblique line or band extending from the spine behind to the middle line of the body in front. In *herpes labialis* the clusters are disposed irregularly about the mouth, generally on the external surface of the lips. Other forms are known as *herpes præputialis*, *herpes phlyctenodes*, and *herpes circinatus*.

The treatment consists in the local application of cooling and soothing remedies, such as dredging the part with flour or some harmless absorbent powder, applying cold cream or zinc ointment, or the use of a lotion composed of oxide of zinc and lime water. These applications may be covered with a sheet of cotton wool and a light bandage. In slight cases local applications are all that is necessary, but in severe eruptions constitutional remedies may also be required.

HER'RICK, ROBERT, a poet, one of whose songs, "Cherry Ripe," is among the most popular of our lyrics, was born in 1591. He was the son of a London silversmith. He was educated well, passing in due time to the University of Cambridge; and taking orders he was presented to the college living of Dean-Prior, near Ashburton, in Devonshire. In 1648 the Parliament "triers" found him too little of the Puritan for their taste, and he was ejected. He came to London and mixed with what poets and literary men he could find, publishing the poems he had written in the west of England, with some London additions, as "Hesperides" (*Hesperis*, the west). Though many of them are love-songs, Herrick was a confirmed bachelor. He was restored to his Devonshire parsonage soon after Charles II.'s return in 1660, and died there in 1674. An excellent edition of Herrick was published for the nominal sum of a shilling in Professor Henry Morley's Universal Library in 1884—a fact showing, if demonstration were needed, the freshness of the poet's writing, which still retains its popularity undiminished, while many weightier and more pretentious authors gather dust upon the shelves, forgotten.

HER'RING (*Clupea harengus*), a fish of the order CLUPEIDÆ, of which it may be regarded as the type, and of the genus CLUPEA. It is a scaly fish, and its teeth are small and numerous. Herrings are marine fishes, congregating in vast shoals, and periodically visiting certain coasts in great multitudes. They are found in the seas of the northern parts of the world, especially in the temperate regions. They deposit their spawn in shallow water, and are very prolific—the roe of a single female herring having been found to contain 70,000 eggs. They are

believed to be inhabitants of deep water, but coming up to the coast in shoals at regular seasons they swim on the surface, and fall an easy prey to larger fish, and also to gulls and sea-birds. They feed on crustaceans and small fishes. The herring is distinguished from other species of the same genus by having an ovate patch of very small teeth on the vomer, fifty-six vertebræ in the backbone, from seventeen to twenty rays in the dorsal fin, and from sixteen to eighteen in the anal, and from fifty-three to fifty-nine scales in the lateral line. The Sprat (*Clupea sprattus*) is a distinct species, and may be easily distinguished by lacking teeth on the vomer and by having from forty-seven to forty-nine vertebræ and forty-seven to forty-eight scales in the lateral line. According to Dr. Günther the whitebait is not a distinct species, but consists chiefly of the fry or young of herrings. The herring of the North Pacific is a distinct species, *Clupea mirabilis*. Fresh-water herrings, so called, are fishes of the genus COREGONUS and family Salmonidæ, and are correctly called *gwyniad* in Wales, *powan* in Scotland, and *pollan* in Ireland. The herring salmon of the North American lakes is of the same nature, and does not belong to the herring tribe.

HERRING FISHERY. The principal season for herring fishing commences in September and ends in December, but to some extent the fishing is carried on all the year round. Yarmouth, Lowestoft, Hastings, Folkestone, Cardigan Bay, and Swansea in England and Wales; the coasts of Caithness, Sutherland, Aberdeenshire, Banffshire, Morayshire, and Ross-shire in Scotland, and the west coast of Scotland generally; and Galway and Killybegs on the coast of Donegal, Mayo, the estuary of the Shannon, the coast between Dingle Bay and Kenmare, Bantry Bay, Waterford, and from Mizen Head to Cahore Point on the Wicklow coast, in Ireland—are the principal localities.

The common mode of taking herrings is by a drift-net, the method of using which is explained in the article FISHERIES. When brought on shore some are sold fresh, but the greater part are cured by means of salt. At Yarmouth and some other places the herrings are, after being slightly salted, made into what are called "bloaters," by a process of smoking.

Herring fisheries have always been the subject of legislative protection in the United Kingdom. An Act passed in 1808 granted bounties to the fishermen, and prescribed regulations for fishing, curing, inspecting, and branding herrings. In 1817 a further boon was granted to the fishermen by allowing them the use of salt duty free, a peculiar advantage which ceased in 1823 by the repeal of the duty on that article. In 1830 all bounties were wholly withdrawn. In 1851, in consequence of the disputes between the drift-net fishermen and those who used the "trawl" or seine-net in the Loch Fyne fishery, the capture of herrings by means of the trawl was declared illegal. By the Acts of 1867 and 1868 the restrictions as to the use of the trawl were removed, sundry commissions being of opinion that trawling was an important means of cheapening fish to the consumer, and had not injured the regular fishery. A "close-time" (January to May) was established along the west coast of Scotland by an Act of 1860. Owing to the misery which this occasioned to a large coast population absolutely dependent on the herring fishery for subsistence, the close time was finally abolished by the Sea Fisheries Act of 1868, except within 3 miles of that part of Scotland which lies between Ardnamurchan Point and the Mull of Galloway. The Sea Fisheries Board, Scotland, have recently been prosecuting inquiries as to the spawning of the herring and the artificial impregnation of the ova, the nature of its food, and other questions of scientific and economic interest. About 1,473,600 barrels of herrings are annually cured in Scotland under the auspices of the Board of White Fish Fisheries. As each barrel of herrings contains on an average 800 fish, the total number of herrings cured in Scotland may be given as about 1,170,000,000. The Scottish Fishery Board, however, only preserves a record of the herrings which are cured (salted), and more particularly of those barrels which are "branded" by its officers; but, in addition to the quantities of herring that are cured and branded, a very large number are sent to market just as they are caught, these being known as "fresh herrings." No official account being taken of these fish, it is not possible to do more than to make a guess at the quantity so disposed of. The statistics of the herring fisheries of England and Ireland are not sufficient to enable a satisfactory estimate to be formed of the number of herrings cured in those countries.

HER'SCHEL, CAROLINE LUCRETIA, sister of William Herschel, the great astronomer, and the sole assistant in his astronomical researches, was born in Hanover in 1750. So highly were her scientific labours in connection with her brother's abstruse calculations appreciated by his Majesty, George III., that he was graciously pleased to grant her a salary sufficient for her moderate requirements. Not only did she execute the whole of the extensive and laborious numerical calculations necessary to render her brother's researches available to science, but she found time at intervals both for actual astronomical observations of her own, and for the execution of more than one work of great utility and extent. With a Newtonian telescope, constructed by her brother, she was in the habit of searching the heavens for comets, and that so effectively as to be rewarded with eight different discoveries from August, 1786, to August, 1797. Her claim to the first discovery of five of them was admitted by the scientific world. During these sweeps of the heavens, Miss Herschel also discovered several remarkable nebulæ and clusters of stars which had never before been observed, and which are recorded in Sir William Herschel's catalogue. Among her astronomical works, which she found time to execute at intervals of leisure, were—(1) "A Catalogue of 561 Stars observed by Flamsteed;" (2) "A General Index of Reference to every Observation of every Star inserted in the British Catalogue;" (3) "A Zone Catalogue," comprehending all the nebulæ and clusters of stars observed by her brother in his sweeps; for which she received the gold medal of the Astronomical Society of London and was elected an honorary member. On the death of her brother in 1822, she left England, where she had resided for about half a century, and returned to her native place, where she died on 9th January, 1848, in her ninety-eighth year. ("Memoirs and Correspondence of Caroline Herschel," by Mrs. John Herschel, London, 1876.)

HER'SCHEL, SIR JOHN F. W., a celebrated astronomer, son of Sir William Herschel, was born at Slough, Buckinghamshire, 7th March, 1792. He received his early education privately, under a Scotch mathematician named Rogers, from whose hands he passed to St. John's College, Cambridge, where he took his bachelor's degree in 1813, coming out as senior wrangler and first Smith's prizeman. In the same year he published his first work, and in 1819 commenced a series of papers in the *Edinburgh Philosophical Journal* on miscellaneous subjects in physical science. He spent the years 1821–23 in making, with Sir James South, a number of observations on the distances and positions of numerous stars, and the following eight years he devoted to re-examining the various nebulæ and clusters of stars discovered by his father. With a view of surveying the southern heavens he left England in 1833, fixed his residence at Table Bay, and carried out a series of observations during the next four years, the result of which was a most valuable addition to astronomical science. His aid was also given to the colonial authorities in various scientific and educational matters. Herschel's residence at the Cape was also productive of considerable benefit to meteorological science, his observa-

tions there in this direction being embodied in a work published in 1844. On his return to England he was received with great public honour, was created a baronet, made honorary D.C.L. of Oxford, and declined a proposal to elect him president of the Royal Society. He accepted the lord rectorship of Marischal College, Aberdeen, in 1842, and was elected president of the Royal Astronomical Society in 1848, the society voting him a testimonial for his work in the southern hemisphere. He held the post of Master of the Mint from 1850 till 1855, resigning it then on account of ill health. Space forbids us to enumerate the many scientific and popular writings of Sir John, forming as they do quite an encyclopædia of information on the various subjects of his research. He was a member of the academies of St. Petersburg, Vienna, Göttingen, Turin, Bologna, Brussels, Naples, Copenhagen, Stockholm, and of almost all other scientific associations in England and America. To his other honours was added that of Chevalier of the Prussian Order of Merit, founded by Frederick the Great, and given at the recommendation of the Academy of Sciences at Berlin. He died 10th May, 1871.

HER'SCHEL, WILLIAM, was the second son of a musician at Hanover, and was born 15th November, 1738. His father brought him up to his own profession, with a good education in other respects. At the age of fourteen he was placed, it is said, in the band of the Hanoverian regiment of guards, which regiment he accompanied to England at a period which is variously stated from 1757 to 1759. Another account states that he came to England alone. After his arrival he was for some time at Durham, where he is said to have superintended the formation of a band for the militia, and afterwards was for several years organist at Halifax, where he employed himself in teaching music and studying languages.

About 1766 he was organist of the Octagon Chapel in Bath, at which place he began to turn his attention to astronomy. Though not a mathematician of the first order, his attainments in that science were more than respectable. The earliest writing of Herschel which has come to our knowledge is the answer to the prize question in the *Ladies' Diary* for 1779, namely—"The length, tension, and weight of a musical string being given, it is required to find how many vibrations it will make in a given time when a small given weight is fastened to its middle and vibrates with it."

His astronomical pursuits led him to desire a telescope, and as the purchase of a good reflector was "fortunately" above his means, he resolved to make one for himself. After many trials he succeeded in making a Newtonian telescope of 5 feet focal length.

Herschel began to contribute to the *Philosophical Transactions* in 1780, and in 1781 announced to the world his discovery of a supposed comet, which soon turned out to be a new planet. [See URANUS.] It is the method which gave rise to it on which this part of Herschel's fame must rest. Perceiving how much depended upon an exact knowledge of telescopic phenomena and a perfect acquaintance with the effect produced by differences of instrumental construction, he commenced a regular examination of the heavens, taking the stars systematically in series, and using one telescope throughout.

The announcement of this comet or (as it turned out) planet drew Herschel immediately into the full blaze of fame; and George III. honoured his reign by immediately attaching the new astronomer to his court under the title of private astronomer to the king, with a salary of £400 a year. Herschel fixed his residence first at Datchet, and afterwards at Slough, near Windsor, and his abode became, as Fourier remarks, one of the remarkable spots of the civilized world. His family consisted at first of one of his brothers and his sister, Miss Caroline Herschel, who was his coadjutor and assistant in his computations and reductions, and was also employed in observation. See HERSCHEL, CAROLINE LUCRETIA.

Herschel married a widow lady, Mrs. Mary Pitt, and left one son, whose name rivalled his father's as one of the most active and successful adherents of science.

Herschel was soon in affluent circumstances, partly by the profits arising from the sale of his mirrors for reflecting telescopes, and partly by the jointure of his wife, which was considerable, and he died wealthy. In 1816 he was presented with the decoration of the Guelphic Order, and in 1820 was chosen the first president of the Astronomical Society. After completing his paper on 145 double stars, which was published in the first volume of the *Transactions of the Astronomical Society*, his health began to decline, and his death took place on 23rd August, 1822.

Herschel will be remembered by the number of bodies which he added to those already known of the solar system, making that number half as large again as he found it. Including Halley's comet, and the four satellites of Jupiter and five of Saturn, the number previously known was eighteen; to which he added nine, namely, Uranus and six satellites, and two satellites to Saturn. His discovery of the rotation of Saturn's ring, his measurements of the rotation of Saturn and Venus, his observations of the belts of the former, and his conjectural theory, derived from observation, of the rotation of Jupiter's satellites, with a large number of minor observations, prove that no one individual ever added so much to the facts on which our knowledge of the solar system is grounded. To this we must add, that his announcement (made in 1803) of the motions of binary stars round each other was accompanied by the first proof that there exists in the universe organized systems besides our own; while his writings on the Milky Way, the constitution of nebulæ, &c., gave an experimental foundation to the conception that what was called the universe might be, and in all probability is, but a detached and minute portion of that interminable series of similar formations which ought to bear the name.

The instrument by which this great work was achieved was the reflecting telescope. The second reflecting surface which is found in the constructions of Newton, Gregory, and Cassegrain, having been rejected, and the eye-piece applied directly to the image produced from the large mirror, forms the distinguishing feature of the Herschelian telescope. Herschel had constructed more than one such instrument of 20 feet focal length before he attempted the enormous one of 40 feet. This instrument was begun in 1785, and Herschel dates the completion from 28th August, 1789, on which day he discovered with it the sixth satellite of Saturn.

HERSE (whence our *hearse*) is simply the French for harrow, from which it came also to signify the harrow-like piece of church furniture standing on tall legs and used formerly to put over a coffin at funeral ceremonies, when it was stuck all over with votive candles. In the sixteenth century herses of great splendour were used, remaining permanently over the graves of the distinguished dead till the marble tomb was completed, fine structures of beaten metal or carved wood, with rich hangings, sometimes even with sculpture, wax images, &c. The lines attributed (wrongly) to Ben Jonson use the word in this sense.

> "Underneath this sable herse
> Lies the subject of all verse—
> Sidney's sister, Pembroke's mother.
> Death, ere thou hast slain another
> Fair, and learn'd, and good as she,
> Time shall throw a dart at thee."

These fine lines were laid on the Countess of Pembroke's herse in Salisbury Cathedral as an epitaph by the author, William Browne. Whalley, in 1756, robbed Browne of them in favour of Ben Jonson. The transition to our funeral carriage is evident.

The herse of modern French Catholic churches is a large triangle of iron carrying spikes to receive candles, and placed in front of an altar for the use of those who wish to make those offerings.

HERTFORD (pron. *Harford*), an English county, is bounded N. by Cambridgeshire, E. by Essex, S. by Middlesex, W. by Buckinghamshire, and N.W. by Bedfordshire. Its length, from N.E. to S.W., is 30 miles; its greatest breadth, N.W. to S.E., 26 miles. Its area is 391,141 statute acres, and the population in 1881 was 203,069. Hertfordshire has no lofty hills. The highest elevations are the Chalk Downs. Kensworth Hill, just within the border of the county, near Dunstable, is 908 feet high. The surface is generally undulating, and from the abundance of wood presents a variety of pleasing scenery.

The rivers for the most part belong to the basin of the Thames. The principal are the Colne and the Lea: the Hiz and some other streams in the northern part of the county belong to the system of the Ouse. The Lea rises in Luigrave or Leagrave Marsh, near Luton, in Bedfordshire. Its whole length, from the source to its junction with the Thames at Bromley, near London, is about 50 miles. The Colne, a feeder of the Thames, rises between Idlestree, or Elstree, and Barnet, and flows through a projecting part of the county of Middlesex into Hertfordshire again, which it leaves at Rickmansworth. The streams which belong to the system of the Ouse have but a small part of their course in this county.

The New River, which was begun in 1608, and which contributes so largely to the water supply of the metropolis, is brought to London from springs in the neighbourhood of Ware. It has a feeder from the Lea near the town, and is carried along the valley and nearly parallel to the course of that stream. It was completed in 1613, when its projector, Hugh Middleton, was knighted by James I. With its windings it is 42 miles long. So little was the benefit of it at first understood, that for above thirty years the shares into which it was divided obtained a dividend of only £5 each. King Charles II. gave up possession of thirty-six shares in consideration of an annual payment of £500, which payment still continues to be made under the title of "King's Clogg." One of these thirty-six shares was sold by public auction in 1823 for £17,050; and the result of a sale in 1884 proved that the value of one of the shares is now over £90,000.

Hertfordshire is comprehended in the chalk basin of London. The south-east and south-west parts are occupied by the London clay, which extends to a line drawn from the Stort, between Sawbridgeworth and Bishop's Stortford, to the north of Ware, Hertford, and Hatfield, to St. Albans, and from thence along the valley of the Colne. To the northwest of this line all the county is occupied by the chalk, excepting a few spots along the border of Bedfordshire, where the subjacent strata crop out. The climate is as mild and genial as that of most of the inland counties. The harvest is early where the soil is light and rich, as is the case in some of the valleys. On the cold wet clays which are found in some parts of the county, and the most exposed tops of the chalky hills, the crops are later.

Hertfordshire was formerly remarkable for its high banks and hedges; but these are rapidly disappearing and being replaced by neat quickset hedges—the ground thus obtained soon paying the expense. There are a very large number of resident landowners in the county, who take a warm interest in the proper cultivation of their estates, and by whom the most improved methods of culture and the newest implements are soon tested. The farms are generally of a good size and the farmers men of capital, and the proximity of London insures a ready sale for all kinds of agricultural produce. The corn crops are reaped as close to the ground as possible, in order that the straw may be sold in the metropolis, and manure brought back in return.

According to the official agricultural statistics published in 1885, there are 340,000 acres under cultivation, of which 140,000 acres are devoted to corn, 42,000 to green crops, 38,000 to clover, and 100,000 acres are permanent pasture. The acreage devoted to wheat is proportionately very large (60,000 acres), the county ranking unusually high in this respect, and being celebrated for its fine white varieties. There are no distinctive breeds of cattle in the county. The number of cattle returned in the agricultural statistics published in 1885 was 30,000, and of sheep 157,000. Garden husbandry has been introduced on the best soils nearest to London for the growth of early potatoes, cabbages, pease, and other culinary vegetables, which are succeeded by other crops. There are many orchards in Hertfordshire, chiefly for apples and cherries, which are sold in London. The manufactures in this county are chiefly confined to paper, straw-plait, and silk; but much malting is carried on. No place in the county is more than 5 miles from a railway station. Hertfordshire is divided into eight hundreds and 134 parishes, and returns, since 1885, four members to Parliament.

History and Antiquities.—At the time of Cæsar's invasion Hertfordshire seems to have belonged to the Catyeuchlani, or Catuellani, of whom Cassivellaunus, the antagonist of Cæsar (B.C. 54), is supposed to have been the chief.

Several of the ancient British roads or trackways crossed this county. The traces of the British Watling Street are obliterated by the Roman road afterwards carried along the same line. Traces of Irmin Street, and still more of Ikenield Street, may yet be recognized. The Romans included Hertfordshire in the province of Flavia Cæsariensis. At Wilbury Hill, 3 miles west of Baldock, is an ancient camp on the Ikenield Way, inclosing about 7 acres.

When the Saxons subjugated Britain Hertfordshire appears to have been included in the two kingdoms of Essex and Mercia. Edward the Elder, son of Alfred, built Hertford Castle.

In the civil broils of the reign of John, Hertford Castle was defended for the king by Walter de Godarvil against the revolted barons and the Dauphin Louis of France. After the general rising of the peasantry under Wat Tyler and Jack Straw, many of the ringleaders were tried and executed at St. Albans. In the War of the Roses this county was repeatedly the scene of contest.

On the breaking out of the war between Charles I. and the Parliament, this county was the scene of one of Cromwell's earliest exploits. While yet a captain of a troop of horse which he had raised, he arrested the high-sheriff of Hertfordshire as he was proceeding to St. Albans to publish the king's proclamation declaring all the parliamentary commanders traitors.

HERTFORD, the capital of the above county and ex-parliamentary borough, is in a low valley below the junction of the Maran or Mimram, and just above that of the Beane with the Lea, which last-mentioned river runs through the town. It is 26 miles from London by the Great Eastern Railway. Hertford is irregularly laid out, but the streets are well paved, and the town is well drained and supplied with water, and has a very clean and neat appearance. It has two parish churches. One of them was erected in 1869, at the cost of Mr. Abel Smith, M.P., in place of an old one which had fallen into a very dilapidated condition. There are also places of worship for all denominations of dissenters. Near the east end of the town is a large building belonging to the governors of Christ's Hospital, London, at which a number of the girls and younger boys of that charity receive their education. The buildings are capable of containing 500 children with their needful attendants. There are also a good grammar-school, the Cowper Testimonial School for boys, and the Abel Smith Memorial School for girls, county hall, corn exchange, free public library, literary and scientific institution, working-men's

club, and numerous charitable institutions. Haileybury College, originally a castle built in the time of James I., and formerly used for the instruction of students intended for the civil service of the East India Company, is at a short distance from the town. It is now used as a public school, and usually has about 500 pupils. No manufacture is carried on at Hertford; but a good deal of business is done in malting, and there are many corn-mills on the Lea, the Mimram, and the Beane. It also has a large corn-market. It is a municipal borough, and is governed by four aldermen and twelve councillors. By the Redistribution of Seats Act of 1885 the borough of Hertford was merged in the county. The population in 1881 was 8718, and the number of voters on the register in 1884 was 1060. Hertford is a place of considerable antiquity. About 905 Edward the Elder built the castle and rebuilt the town, which had probably been ruined by the Danes. John II., king of France, and David, king of Scotland, spent part of their captivity here during the reign of Edward III. Queen Elizabeth occasionally resided and held her court in the castle.

HERZEGOVI'NA, THE (a term meaning the territory governed by a Herzog or Duke), an extensive tract of country situated on the eastern shores of the Adriatic, formerly known as Turkish Dalmatia. In recent years it assumed importance from the repeated resistance to Turkish domination, of which Herzegovina formed the centre and starting-point. The country is about 120 miles long and 72 miles broad at its greatest length and breadth, with an approximate area of 8000 square miles, and a population of about 213,000. On the N. its boundary is Bosnia; on the E. Servia; on the W. Dalmatia; on the S. Montenegro and the Adriatic.

Though the Herzegovina may be pronounced comparatively sterile and unproductive, it yet has certain resources which, if properly developed, would materially change both the character and reputation of the country. The mountain ranges which intersect a great part of the province, and which are spurs of those Dinaric Alps which fringe the shores of the Adriatic from Scutari northward nearly to Trieste, give place further inland at intervals to plains and pasture lands capable of a high degree of cultivation, and bearing a soil well adapted to the growth of the vine, the olive, and the mulberry. The mountains themselves towards the Bosnian frontier are clothed with dense forests of oak, ash, elm, beech, walnut, maple, and pine, but the trees grow only to decay. Tobacco and grapes are grown, but the former only for the sufficing of local demands; while, as regards wine, quantity is considered more than quality. Sheep and horned cattle find their way into the Dalmatian markets, and wool, hides, skins, honey, and wax into those of Austria. Dalmatia, again, with Bosnia and Servia, receive the only manufactures of which the country can boast, carpets and coarse woollen blankets; while a kind of cotton cloth, made by the women from imported cotton, is applied solely to domestic uses.

Herzegovina formerly belonged to Croatia, when that kingdom was independent; but in 1326 it was incorporated with Bosnia. Under the Emperor Frederick III. it became an independent duchy; but after many protracted contests with the Ottoman arms, it was finally ceded to Turkey by the peace of Carlovicz in 1697. The Porte once more incorporated it with Bosnia, and it was retained by that power for two centuries. The population consists of 120,000 Christians, 80,000 Mussulmans, some 5000 Jews, and about 10,000 gypsies.

The Herzegovinians, Bosnians, Montenegrins, and Servians may be properly regarded as forming one nation, identical in race, history, and language. They formed in the middle ages one civilized kingdom, the traditions of which are remembered with pride by the poorest cottager. In 1875 an insurrection against Turkey, always imminent, broke out, and Bosnians and Herzegovinians made a resolute attempt to throw off the Turkish yoke; and for a long time the measures taken to put down the revolt were utterly ineffectual. Hardly pressed, however, by the large forces of the dominant power, the people called on their brethren in Servia to help them. The Servians remembered what the Turkish yoke was, and having been already stung into fury by the sufferings of their neighbours, they did not hesitate long before responding to the call. Hostilities against Turkey were commenced, and it would be difficult to say that the ungovernable impulse of a free and generous people to join in such a war was not creditable, though it may have been in the eyes of statesmen imprudent, even technically unwarrantable, and for a time unsuccessful. It was this war, arising out of the Herzegovinian insurrection, which introduced Russian intervention in 1876. The atrocities committed in Bulgaria gave further colour to Russian pretexts for interference on behalf of Christians in Turkey, and led to the flames of a wider and more desolating war, which broke out in 1877. By the treaty of Berlin the government of Bosnia and Herzegovina was confided to Austria-Hungary, while Niksich and the country about Mount Dormitor were detached from Herzegovina and annexed to Montenegro. The Austrian occupation aroused the Mohammedans, who believed they had been betrayed by the Turkish government, to a desperate resistance; but it proved useless, and the country is now under the military governor of Serajevo, controlled by the foreign office at Vienna, although the sultan still remains sovereign *de jure*.

HES'IOD (Hēsiodos), a Greek poet of very early date, respecting whose age and life very little is certainly known, but of whose works some valuable remains have come down to us. In one of these, the "Works and Days," he informs us that his father emigrated from Cuma in Æolis, and settled near Helicon at the miserable village of Askra in Bœotia, where he appears to have been born. He states that he never crossed the sea, except from Aulis to Eubœa, when the Greeks collected a great army for Troy (a passage probably an interpolation of later date); and adds that, in Chalcis, he gained a tripod as a prize for his poetry, and consecrated it to the muses of Helicon. He describes himself as feeding flocks near Helicon, from which and other circumstances it is inferred that he occupied an inferior station in life. Herodotus makes him a contemporary of Homer, and 400 years earlier than himself, which would fix his birth at about 884 B.C. But circumstances lead scholars usually to set his date at about a century later than this. Hesiod had a brother named Perses, whom he frequently names, and it is inferred from a fragment of Pindar that he removed from Askra to Orchomenos, where he died and his tomb was afterwards shown. Plutarch mentions a tradition to the effect that Homer contended with Hesiod at Chalcis, and that Hesiod carried off the prize. The compositions which bear the name of Hesiod are but few. The first is the "Works and Days," a purely didactic poem. According to Pausanias, the Bœotians who lived near Helicon had a tradition that Hesiod left no work except this, and even this they regarded as interpolated. This opinion is partly correct, and modern critics do not think it entirely his work, but made up of different poems, some more recent, and others his own. It is plain and simple in its style, and exhibits no power of imagination. Its precepts relate to morals and politics, to seafaring men and to domestic life. Its references to agriculture and household matters furnish curious illustrations of the manners of ancient Greece. It contains, inserted roughly, the beautiful myth of Prometheus and Pandora, coming oddly amidst its plain didactic precepts. Hesiod's other chief poem is his "Theogony," in which he treats of the origin of the world and of the gods. This poem also must be regarded as in part at least spurious. It narrates the

origin of the world, of the gods, and of heroes. Except in its dialect it differs materially from the "Works and Days." Another piece, the "Shield of Herakles," appears to contain a fragment of a poem by Hesiod at the commencement, but the substance of it is certainly not his. The titles of several other poems ascribed to Hesiod are to be met with in ancient authors, and various fragments of them are extant. These fragments are to be found in different editions, as in that of Didot, edited by F. S. Lehrs. Notwithstanding the homely simplicity of the Hesiodic poems they were much read by the ancients, and deserve the attention of all who are interested in the subjects of which they treat. These poems were first printed in 1493. The best modern edition is that of Göttling (Gotha, 1843).

HESPER'IDES, in Greek mythology, a family of nymphs, the daughters of Atlas by Hesperis, the daughter of Hesperus. They dwelt in a beautiful garden in the western parts of the earth, in which grew the celebrated tree which bore golden apples. These apples were guarded by a fierce dragon named Ladon, which never slept. Herakles nevertheless succeeded in obtaining some. The gardens of the Hesperides are variously placed—in an oasis of the African desert, in Cyrenaica, at the foot of Mount Atlas, and in the Happy-Islands of the Atlantic.

HESPERI'IDÆ. See SKIPPER.

HES'PERIS, a genus of plants belonging to the order CRUCIFERÆ and the tribe Sisymbreæ. The flowers emit a sweet fragrance in the evening, and hence the genus derives its name. *Hesperis matronalis* (dame's violet) is a native of Europe, and is found, though rarely, in hilly pastures in the British Isles. The large handsome flowers are of a lilac colour. The pod is contracted between the seeds. Transplanted to the garden, it varies considerably in colour, forms occurring with white, red, purple, and variegated flowers; as it grows 2 or 3 feet high, it is showy and well worth cultivating. Single and double flowers are grown, the latter requiring occasional transplanting. Clumps of the single flowers look showy in woods and shrubberies. This plant is also known as queen's gilliflower, rocket, or damask violet. *Hesperis tristis* (night-scented stock) is rather dull-coloured, but it is sweet-scented at night. There are about twenty species, natives of Europe, Asia Minor, Persia, and Siberia; they are biennial or perennial herbs with entire leaves. The sepals are erect, the petals clawed, stamens free, stigma lobes erect, pod narrow and elongated, seeds several in one row, and the cotyledons incumbent.

HESPEROR'NIS is the generic name given by Professor Marsh to a very remarkable fossil bird from the cretaceous rocks of the United States. *Hesperornis regalis* was a gigantic aquatic bird, standing between 5 and 6 feet high. Its nearest living allies are the divers (Colymbidæ). Teeth are found in the skull, fixed not in separate sockets, but in deep continuous grooves; they had sharp crowns and were covered with enamel. Teeth were not found at the extremity of the jaw, where their place was taken by a bill. The wings were quite rudimentary. The breastbone had no keel. The vertebræ were of the usual bird-like character. Professor Marsh supposes that this bird was carnivorous in its habits.

HES'PERUS, the evening star, was formerly the star of twilight, either morning or evening, and it is as a morning star that he gets his name of "light-bringer" (Heôsphoros). The Romans also call the star Lucifer, which is a translation of the word Hesperus, light-bringer. Hesperus is now limited to the evening star. In the Greek mythology the god of this star was a son of the Titan Astræos and Eôs (the dawn), and brother of the winds.

HES'SE (*Hessen* in German), an extensive country of Germany, which in ancient times was inhabited by the Catti. Till the thirteenth century the history of Hesse was blended with that of Thüringen, but Henry Raspe, landgrave of Thüringen, dying without children in 1247, a war for the succession took place, which was terminated in 1263 by a compact, by which Hesse was separated from Thüringen and assigned to Henry, son of Sophia, duchess of Brabant, daughter of the late landgrave's brother, who was the common ancestor of all the succeeding landgraves of Hesse-Cassel and the dukes of Hesse-Darmstadt. The name Hesse is now applied to the grand-duchy formerly known as *Hesse-Darmstadt*, which is governed by the second main branch of the house of Hesse. It was founded in 1567 by George I., on whose death his dominions were divided among his three sons. Louis V. succeeded him in the principal line; Philip obtained Butzbach, which reverted on his death to the main line; and Frederick, the youngest, was the founder of the junior line of Hesse-Darmstadt, namely, that of Hesse-Homburg. Excepting the ruinous effects of the Thirty Years' War, the reigns of the succeeding princes were on the whole prosperous, and various acquisitions of territory were made. Louis IX., who reigned from 1768 to 1790, was a friend of peace and a patron of the arts and sciences. He found the country burdened with a large debt, which he paid off, and left to his son, Louis X., an improved territory, with 300,000 inhabitants. This prince, during his long reign of forty years, was a greater gainer than almost any other German sovereign by the French Revolution; he acquired very large additions to his dominions, and first assumed the title of grand-duke as Louis I.

The grand-duchy of Hesse-Darmstadt until 1866 consisted of two large portions, separated from each other by a long strip of land, extending from east to west, belonging to Hesse-Cassel and the city of Frankfurt, and situated between 7° 50′ and 9° 40′ E. lon., and between 49° 12′ and 51° 20′ N. lat. The area of the whole was 3237 square miles, and the population in 1861 was 856,907. There were detached from the grand-duchy and annexed to Prussia, in consequence of the war of 1866, with several districts north of the river Maine, comprising a total area of 377 English square miles, and a population of 46,605; while Prussia ceded to the grand-duchy portions of the electorate of Hesse, of the former duchy of Nassau, and of the former free city of Frankfurt. In 1881 the population was 936,340.

A large part of the surface of the country is mountainous. The banks of the Rhine and the Wetterau, which contain about 400 square miles, are pretty level; the remainder of the country is traversed by branches of the Vogelsgebirge, the Odenwald, Taunus, and the Westerwald. Hesse is on the whole an agricultural country. The soil is among the most fertile and best cultivated in Germany. The chief productions are corn of all kinds, flax, hemp, hops, tobacco, pulse, potatoes, wines, both white and red, garden vegetables and fruit, and timber. The southern districts, in which most of the fruit is grown, are specially noted for the excellence of their wines. The valleys of the Odenwald and Vogelsgebirge are well adapted for the breeding of cattle, of which there are large numbers. Mining is not carried on so extensively as might be expected; it is confined to copper, iron, coals, salt, and brown coal. Cobalt, basalt, lime, sandstone, marble, and slate are found in different parts of the grand-duchy. The chief rivers are the Rhine (2500 feet broad at Mainz), and the Main, and next to these the Lahn, the Schwalm, the Nidder, the Ohm, and the Itter. The climate is cold, except in the valley of the Rhine.

The chief manufactures are woollens, cottons, and linen, leather, and hardware. There is also a trade in silks, paper, chemical products, and metals to a small extent. The most considerable manufacturing and trading town is Offenbach, which has two annual fairs. Mainz is the principal place for the transit trade. The exports consist of the agricultural productions of the country and of some

manufactures. The imports are principally colonial and manufactured goods.

The country is well supplied with good roads and railways. The steam navigation of the Rhine, Main, and Neckar affords still more extensive means of communication, but has the disadvantage of being partly or wholly closed in the winter months.

The constitution bears date 17th December, 1820; but was somewhat modified in 1848, and again in 1856 and 1872. The legislative power is vested, in part, in two chambers, called the Upper and Lower House of Representatives. The former is composed of the princes of the reigning family, of the heads of a number of noble houses, the Roman Catholic bishop, the chief Protestant superintendent, the chancellor of the University of Giessen, and a number of life members, not exceeding ten, nominated by the grand-duke. The Lower House consists of ten deputies of towns and forty representatives of villages and rural districts. The latter are chosen in a tripartite mode of election—the original voters first polling the "electors;" these, in their turn, choosing "deputies," and these again the final representatives. The chambers have to meet at least once every three years. On certain occasions both houses vote together, as when a proposition of the government has been accepted by one house and refused by the other, and a final decision is to be arrived at. No changes in the laws can take place without the sanction of the chambers, but they never assume the initiative in legislation; they have only the right of petitioning for new laws, which are then submitted to them by the minister. Every subject enjoys freedom of person and property and the free exercise of religion; all are equal under the law, and all, except the members of the mediatized noble houses, are liable to military service. The press is free, and the abuse of its freedom is cognizable only by the civil law.

The revenue amounts to about £1,000,000 per annum, and the expenditure to nearly the same amount. The public debt is £1,400,000, the greater part of which was incurred for the establishment of state railways.

Hesse has a good university at Giessen. There are also superior schools and various literary and scientific societies in the chief towns, and at least one elementary school in each commune. Public instruction has made rapid progress of late, especially in the province of Rhenish Hesse. At the last census the population consisted of 635,000 Protestants, 270,000 Roman Catholics, and 30,000 Jews.

HES'SE-CAS'SEL. See HESSE-NASSAU.

HES'SE-NAS'SAU (*Hessen-Nassau*), a province of Prussia, formed of the former electorate of Hesse-Cassel, the duchy of Nassau, the landgraviate of Hesse-Homburg, the free state of Frankfurt, and parts of Hesse-Darmstadt and Bavaria, ceded to Prussia by the treaty of Berlin in 1866. It is bounded on the N. by the province of Westphalia, E. by Prussian Saxony and the states of Saxe-Weimar and Bavaria, S. by the south part of the grand-duchy of Hesse, and W. by the Rhine provinces, the province of Westphalia, and the principality of Waldeck. It is situated between 50° and 51° 40′ N. lat., and between 7° 40′ and 10° 10′ E. lon. The total area is 6137 English square miles, and the population in 1881 was 1,554,376, of whom about 1,100,000 were Protestants.

The country is in general hilly, but it contains numerous valleys, which in some places expand into more extensive plains. On the south-east and south the Thüringerwald, the Rhön, and the Spessart extend their branches into the country from Saxony and Bavaria, and cover the whole tract between the Werra and the Fulda. The other principal chains are the Hundsrück, the Wesergebirge, and the Vogelsgebirge. The soil is, on the whole, very fertile and well adapted for agriculture. The climate is generally temperate, though sometimes severe, but it is everywhere healthy. The principal rivers are the Weser with its branches the Werra and the Fulda, and the Rhine with its affluents the Lahn and the Main.

The mountains follow the Rhine and the Lahn in their whole course, and form delightful valleys, which are among the most romantic parts of Germany; the most picturesque is the Rheingau from Biberach to Sorchausen, celebrated for its fine wines. That produced about Hochheim is well known by the name of hock; there are likewise the wines of Steinberg, Marcobrunn, Asmannshausen, Rüdesheim, and Johannisberg. Corn, maize, pulse, and potatoes in great abundance are cultivated. The latter form the chief article of food in some districts, and they are also used in the distilleries. Tobacco, esteemed the best in Germany, is grown in Hanau and on the banks of the Werra in Schmalkalden. Flax, also, of good quality is cultivated. Orchards are everywhere numerous; hemp, hops, chicory, poppy seed, and culinary vegetables are also extensively grown. The province is one of the most richly-wooded districts in Europe; nearly one-third of its surface, particularly in Fulda, Hanau, and Schmalkalden, is covered with forests. These forests abound in game, and supply vast quantities of timber and firewood. The rivers yield an abundance of fish and crustaceans. The pastures are good, but cattle are not so numerous as might be expected. Hogs and poultry are plentiful. The peasantry, like their neighbours throughout Westphalia, are principally hereditary tenants; and there are men among them who boast of being able to prove that they still cultivate the same farms on which their ancestors lived before Charlemagne conquered the country.

Mining is pursued more or less in all parts of the country. The principal products are silver, copper, iron, quicksilver, manganese, cobalt, salt (from saline springs, and in considerable quantities), saltpetre, vitriol, and alum. Ironstone of the best quality (including red ironstone and brown ironstone containing manganese) is extensively exported, as well as manganese in a raw state. There are also coals, marble, very fine white alabaster and porcelain, potter's and pipe clay. Turf is abundant and is used for fuel. The country has numerous spas and mineral springs, Ems and Wiesbaden being among the most celebrated in Germany.

The most important manufactures are linen fabrics, called Osnaburgs, flannels, carpets, cottons, silks, and velvets; iron and steel goods of every description, paper, wooden wares, pianos, chemical products, tobacco, beetroot sugar, pottery, and jewelry are also made. Linen weaving and spinning form throughout the country the common auxiliary employments of the small farmers and their families. The fabrics are of every quality, from the coarsest household cloths to the finest damask. There are many bleaching and dyeing establishments, breweries, and distilleries in different districts. The Rhine and the Lahn are both navigable, and the province is also intersected by railways.

The majority of the inhabitants belong to the Reformed or Calvinist Church, the affairs of which are managed by consistories at Cassel, Marburg, Hanau, and Wiesbaden. The Lutherans are under a general superintendent, and the United Evangelicals carry on their own ecclesiastical government by a central committee and occasional synods. A Roman Catholic bishop at Fulda is at the head of the Catholic Church.

Within the last few years great improvements in education have been made. Numerous elementary schools have been established, and there are few grown-up persons to be met with who are unable to read and write. The upper educational establishments comprise the University of Marburg, the Military and Polytechnic School at Cassel, and the Theological Seminary at Fulda. The latter is for Roman Catholics; the Protestants have similar establishments at Cassel, Marburg, and Hanau. The University

of Marburg, founded in the year 1527, has on the average between 300 and 400 students.

HESSE'NES. See ESSENES.

HES'SIAN FLY (*Cecidomyia destructor*), a fly which has done much damage to wheat in America. It has got its name from the idea that it was introduced into North America with the baggage of the Hessian troops in the service of England during the War of Independence. The larvæ of this fly live on the leaves of wheat, and cause great destruction. The perfect insect is black, with dusky wings and the under surface of the abdomen red. This insect is double-brooded, the perfect insects appearing in April and again about the end of August. The Hessian fly also occurs in some parts of Germany. It belongs to the order Diptera, division Nemocera, genus CECIDOMYIA.

HES'TIA, goddess of the hearth in the Greek mythology, is almost identical with the Latin *Vesta*. She was one of the twelve great divinities, and was held to be the first child of Kronos and Rhea, and was accordingly, like all the other children, swallowed by her father, and like them too was afterwards saved. Her brother Poseidôn and her brother's son Apollo (son of Zeus) both sought to marry her, but she preferred to remain unmarried, and swore solemnly that she would stay a virgin. The worship of Hestia was very extended. She was the goddess not only of the house-fire but of the city *pyrtaneion* and of the altar-fire of the temple. Every sacrifice was first offered in part to her, every vow included her name, and suppliants for mercy claimed her protection as they touched the altar, to whatever deity the latter might be consecrated. Colonists took the sacred city fire to their new home, that Hestia might follow them, and if by accident it went out no ordinary means were used to kindle it, but only the fire of the sun through burning glass falling on tinder, or the rubbing of two sticks together. Hestia was emphatically the family goddess, giving all domestic felicity, and loving the inner parts of houses.

HETERO'CERA (Gr. *heteros*, different; *keras*, horn) is one of the two divisions of the order LEPIDOPTERA, and comprises the insects known as MOTHS. The name has reference to the character of the antennæ, which are always more or less tapering towards the tip, whereas the same organs in butterflies are always furnished with a knob or club at their tip.

HETEROCER'CAL and **HOMOCER'CAL,** terms applied to the caudal fins of fishes. In ordinary bony fishes (Teleostei) the caudal fin is externally symmetrical or homocercal, being sometimes forked (fig. 1) or crescent-shaped (fig. 2) with two equal lobes, sometimes rounded (fig. 3); other variations in shape occur, but the upper portion in the homocercal fin is equal to the lower. In the sharks and sturgeons the caudal fin is asymmetrical or heterocercal, the upper lobe being developed out of all proportion to the lower (fig. 4). In the heterocercal form of

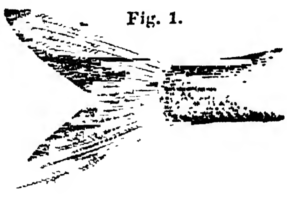


Fig. 1.


Fig. 2.

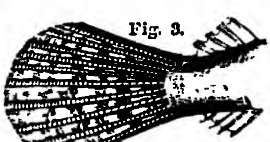


Fig. 3.

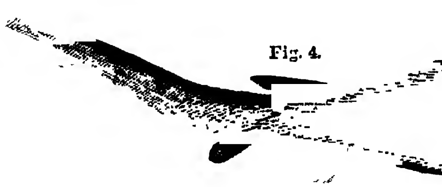


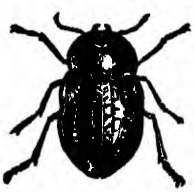
Fig. 4.

tail the vertebral column is prolonged through the upper lobe. In the homocercal tail the last vertebra occupies a central position at the base of the fin, and articulates with a fan-shaped bone (hypural), which lies in the upper lobe; the hypural bone is a union of modified processes (hæmapophyses) of vertebræ which are directed backwards, and the actual termination of the notochord is bent upwards, and lies along the upper edge of the hypural, hidden below the last rudimentary neural elements. In some teleosteans, as the Salmonidæ, the last vertebræ are conspicuously bent upwards; in fact, strictly speaking, this homocercal condition is but one of the various degrees of heterocercy, different from that of many ganoids in this respect only, that the caudal fin itself has assumed a high degree of symmetry (Günther). A truly symmetrical caudal fin (diphycercal) is found in the mud-fishes (Dipnoi), some rays, and some ganoids. The ordinary bony fishes in the course of their development pass through these three stages; the embryo having first a diphycercal form of fin, afterwards acquiring the heterocercal shape, and lastly the homocercal.

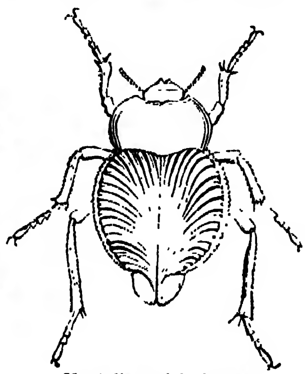
HETERO'CERUS is a genus of beetles forming the family Heteroceridæ, belonging to the group CLAVICORNIA. These beetles have small oval depressed bodies, flattened broad limbs armed with spines, and eleven jointed antennæ, the last six articulations forming a cylindrical club. They live in sand or mud, by streams or among marshes, burrowing in the ground by means of their spinous tibiæ. When disturbed or alarmed they come out of their holes. The larvæ live in the same situations with the perfect insects. Upwards of seventy species have been described, distributed over nearly the whole of the world.

HETERO'GYNA is a section of the order HYMENOPTERA, containing the social ants. The name has reference to the fact that in addition to the male and female insects a third variety is found in the nests, the so-called "neuters," which are abortive wingless females, sometimes of two kinds, workers and soldiers. See ANT.

HETEROM'ERA is one of the four sections into which beetles (Coleoptera) are divided. This section is characterized by the possession of five joints to the tarsi of the first two pair of legs, the third pair having only four. It contains numerous aberrant beetles; many are parasitic in their early stages, and some in their perfect state. The remarkable family Stylopidæ, which at one time formed a distinct order, Strepsiptera, is now placed in this section near the oil-beetles (Moloidæ). Nearly all the Heteromera are vegetable feeders. This section is subdivided into two groups—TRACHELIDA, in which the head is narrowed into a neck, and ATRACHELIA, in which the head is immersed in



Helæus echidna.



Nyctelia multicristata.

the prothorax. Among the beetles included in this section are the Spanish-flies, the oil-beetles, the churchyard beetle, and the meal-worm. As examples we figure *Helæus echidna* from Australia, having the elytra armed with short spines, and *Nyctelia multicristata*, a South American form.

HETEROMOR'PHIC MINERALS, those which, although of a particular chemical constitution, crystallize in forms belonging to different crystallographic systems, and have usually marked differences in their physical characters. These minerals may be dimorphic, trimorphic, or polymorphic. In nature each form is recognized as a distinct mineral species.

Sulphur is a good example of a trimorphic substance, as the conditions under which each form can be produced are known. When melted sulphur, heated to 200° C. (360° F.), is poured into water, a dark brown plastic substance is produced, which has a specific gravity of 1·92, and is insoluble in bisulphide of carbon. In nature sulphur occurs as yellow rhombic pyramids, which are soluble in bisulphide of carbon, and have a specific gravity of 2·06. This form may be obtained artificially by the spontaneous evaporation of a solution of sulphur in bisulphide of carbon, or when a large mass of molten sulphur cools slowly. There is also a monoclinic form of sulphur obtained by allowing molten sulphur to partially solidify, then on pouring off the still liquid portion transparent acicular monoclinic crystals will be found covering the vessel. These have a specific gravity of 1·96 and melting-point of 120° C., but are very unstable and quickly revert to the normal type, becoming converted into minute rhombic crystals.

Carbon is a trimorphic substance; it occurs in an amorphous state as coal, soot, lampblack, &c. The DIAMOND is one of its crystalline forms, crystallizing in the cubic system, has a specific gravity of 3·55, hardness of 10, and is a non-conductor of electricity. Graphite is carbon crystallized in the hexagonal system; it has a specific gravity of 2·3 and hardness of 1·5, and is possessed of a considerable degree of electric conductivity. Antimonic oxide (Sb_2O_3) occurs in the cubic form in senarmonite, and in the rhombic form in valentinite.

Silica (SiO_2) occurs in four states. When fused by the oxyhydrogen blowpipe it forms an amorphous glass, having a specific gravity of 2·2, similar to the substance occurring in the minerals OPAL, HYALITE, &c. Three crystalline varieties occur:—

(1) Quartz, which crystallizes in the hexagonal system in tetartohedral forms; it has a specific gravity of 2·66.

(2) Tridimite also crystallizes in the hexagonal system, but in HOLOHEDRAL forms, and has a specific gravity of 2·3.

(3) Asmanite crystallizes in the rhombic system, and has a specific gravity of 2·24.

Titanic acid (TiO_2) is trimorphic:—(1) Rutile crystallizes in the tetragonal system, and has a specific gravity of 4·25.

(2) Anatase also crystallizes in the tetragonal system, but has a specific gravity of 3·9.

(3) Brookite crystallizes in the rhombic system, and has a specific gravity of 4·15.

Carbonate of lime is dimorphic, ARAGONITE being its rhombic form; it has a specific gravity of 2·9. It has been shown by G. Rose that this form is that deposited from boiling solutions. It is, however, somewhat unstable, and tends to revert to the more normal type, CALCITE, which crystallizes in the hexagonal system, has a specific gravity of 2·7, and is deposited from cold calcareous solutions.

HETEROP'ODA is the name applied to a group of free-swimming marine molluscs belonging to the class GASTEROPODA. The Heteropoda are often considered as forming an order of Gasteropoda or even a distinct class. By recent authorities this group has been regarded as a special branch of the order Prosobranchiata, having their structure modified in adaptation to their changed mode of life, swimming freely near the surface of the ocean. Two families are included in this group—Atlantidæ [see ATLANTA], which possess a well-developed shell and a foot but little modified from the gasteropod type; and FIROLIDÆ, in which the shell is minute or absent, the body more or less slug-like, and the foot forms a kind of fin. In all this group the sense organs are well developed.

HETEROP'TERA is a suborder of Hemiptera, an order of insects. The fore wings form a protective covering for the delicate membranous hind wings; they are thick and horny at their fore part and membranous at their extremity, and hence are termed hemelytra. The rostrum springs from the fore part of the head. The families composing this suborder are noticed in the article HEMIPTERA.

HET'MAN, a title given to the chief general of the old Polish armies, and now applied by the Czar of Russia to the chief general of his Cossack forces.

HEU'CHERA, a genus of plants belonging to the order SAXIFRAGEÆ, and consisting of about twenty species. *Heuchera americana* is a native of North America, where it has obtained, on account of its astringent properties, the name of alum root. It contains tannin, and it is to this principle that its astringent character is to be ascribed. The other species contain tannin, but are not used for any purpose in the arts or medicine. *Heuchera americana*, together with *Heuchera glabra* and *Richardsoni*, are cultivated. "They form compact rounded tufts of foliage which in some cases are beautiful, being of a satiny deep green colour, but veined and washed with reddish brown" (Robinson, "English Flower Garden," 1883). A rich peaty soil should, if possible, be given them. They are good plants for growing in masses, or for edging evergreen shrubberies; they also look well on rockeries. *Heuchera americana* has dull purplish flowers with doubly crenate root-leaves. *Heuchera micrantha* has bright purple flowers and lobed leaves. The leaves of *Heuchera Richardsoni* (satin-leaf) have blunt crenated lobes; the flowers are pale purple or yellowish. *Heuchera pubescens* is a fine plant with large pale-red flowers. *Heuchera sanguinea* is hardy, the leaves are lobed, and of a light green colour; this plant is perhaps of all the species the

most beautiful and delicate in form. The species are all natives of North America, from Mexico to the Arctic regions. As nearly all the species are natives of a climate similar to our own they can readily withstand the cold of our winters, if they are placed in a proper situation, with good soil. They are annual herbs, with a thick perennial rhizome and white flowers borne on a scape. The leaves are radical, roundish, with long petioles and membranous stipules. There are five entire petals, five stamens, an inferior one-celled ovary, numerous ovules on two parietal placentas, alternate with the stigmas; the fruit is a two-beaked capsule.

HEU'LANDITE is the name of one of the ZEOLITE group of minerals. It crystallizes in the monoclinic system, has a hardness of from 3·5 to 4, specific gravity of 2·2, and is composed of hydrous silicate of alumina and lime; it occurs in cavities of amygdaloidal rocks, as basalts, and in certain metalliferous veins. Its reddish colour is due to inclosures of orange-yellow particles, supposed to be either goethite, limonite, or hematite.

HEVE'LIUS, JOANNES, or more properly *Joannes Hevel*, a Polish astronomer of great eminence, was born at Dantzic, of a noble family, 28th January, 1611. He applied himself almost exclusively to the study of astronomy. In 1641 he built an observatory in his own house, and furnished it with a quadrant and sextant of 8 and 4 feet diameter, together with large telescopes constructed by himself. In 1647 he published a description of the moon, under the name of "Selenographia," to which was added a representation of the other planets as seen by the telescope. In 1654 appeared his treatise "De Motu Lunæ Libratorio," in the form of a letter to Riccioli, wherein he gave an explanation of the libration of the moon. To these succeeded various other works, and in 1673 the first part of the "Machina Cœlestis" was published. In 1679 he sustained considerable loss by the destruction of his house and observatory by fire. This accident appears only to have had the effect of increasing his ardour in the pursuit of astronomy, for he shortly after erected a new observatory, though on a less magnificent scale, and by 1685 he had another volume of observations ready for publication. He had now been occupied forty-nine years as an observer, and had attained sixty-three years, the climacteric, as it used to be called, of life, for which reason this volume (the last published during his lifetime) is entitled "Annus Climactericus." His posthumous works are "Firmamentum Sobieskianum" (1690) and "Prodromus Astronomiæ" (1691). He died at Dantzic, universally respected, in 1687, in his seventy-sixth year.

HEX'ACHORD, a name given by the ancient Greeks to a lyre of six strings and also to a scale of six sounds. But the hexachords which demand most attention are those extraordinary six-note scales of the mediæval musicians which are so perplexing to us moderns to manage or to comprehend. That a musician who knew and used the scale C D E F G A should not proceed to the Octave through the Seventh, seems blindness nothing short of miraculous. But we must remember, first, that harmony in our sense of the word practically did not then exist; and secondly, that at the revival of music in the dark ages the scale of six notes replaced a scale of four (the ancient Greek *tetrachord*), and gave a sense of freedom, not a sense of limitation). True, the later Greek philosophers and musicians had much the same scale as our minor scale (with a minor not a major seventh, however); but in the early times of Guido and Hucbald the art seems to have been re-learnt from the humblest Greek beginnings.

As seen above, the men of the dark ages had no feeling for harmony, except the bare consonance of octaves, as when men and boys sang the same melody or the bare Fifth of the ORGANUM. Their view of music was melodic. Consequently a scale of successive notes must be related by feelings of melody, not of harmony. For ourselves we refer every note of the scale to the key-note; the second of the scale is a major Second to it, the Third is a major (or in the *minor* scale a minor) Third, the fourth a major Fourth, &c. But to men who, as harmonics, only used Octaves and Fifths (with their inversions Unisons and Fourths), and who heard, without making use of their knowledge, the smoothness of Thirds and Sixths, the power of singing a Second (a harsh discord) was only attainable through both notes entering into some easy relation with some other note. Thus a man could pass from C to D, not because he felt any relation between them (as we do, supposing C to be the key-note), but because they are the Fourth and Fifth of G, the all-important dominant of the key. He passes with rather less ease from D to E than from the Fifth to the Sixth of G. E to F stands as the progression from the Third to the Fourth of C, F to G the Fourth to the Fifth, G to A the Fifth to the Sixth of C. Here he must stop. The Seventh of C is no concord easily learnt by its smoothness; it is a discord, bearing no melodic relation to the A preceding it, but on the contrary clinging tightly to the C which follows it. Sound B in the key of C and you are driven on to the key-note perforce, which is why in England we call it the leading note; in France they call it *la note sensible*. The musician of the dark ages therefore stuck fast at A; the step from A to B was unrelated either to C or to G by such intervals as he could comprehend, and he could not take it.

This psychological explanation seems necessary to put ourselves in the point of view from which a thing to us not only natural, but inevitable, was impossible. We cannot help singing an octave scale; they, who knew the octave itself as well as we do, had no notion of reaching it.

In the article GUIDO D'AREZZO is given the hymn to St. John, the initial syllables of the first six lines of which gave us the well-known syllables *ut*, *re*, *mi*, *fa*, *sol*, *la*. (*Si*, for the Seventh, is a later addition; *do*, for the tonic, is used for *ut* as being more melodious.) The three hexachords of the dark ages started from C, from G, and from F, and followed the pattern of the six white notes of the pianoforte from C to A. Thus there was one semitone in the scale, which was always from *mi* to *fa*. This gave the curious anomaly of a *b*♮ alone in the lower notes (in the G hexachord), and both a *b*♮ and a *b*♭ in the upper notes (in the F hexachord); for which reason the first was called the *hard hexachord* (with *hard b*), and the second the *soft hexachord* (with *soft b*); while C, which did not contain the awkward note, was the *natural hexachord*. The three scales were as follows:—

	ut	*re*	*mi*	*fa*	*sol*	*la*
Hard hexachord,	G	A	B	C	D	E
Natural "	C	D	E	F	G	A
Soft "	F	G	A	B♭	C	D

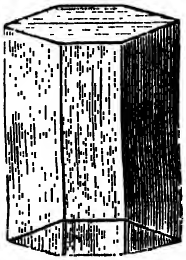
But we can see that we get a terrible overlapping here, for only the first three notes of the hard hexachord (G A B, at the bottom of the bass stave) are simply in one hexachord. On C (*c*) the natural hexachord joins in, and its *ut* corresponds with the *fa* of the hard hexachord, its *re* with the other's *sol*, and its *mi* with the other's *la* (*C-fa-ut*, *D-sol-re*, *E-la-mi*). But here, while the hard hexachord stops, the natural hexachord is overtaken by the soft hexachord, and the note F (*f*), which is *fa* in the first, is *ut* in the second (*F fa ut*). The next note makes matters worse, for the second scale of the hard hexachord begins again, and G (*g*) serves for all three of them—*sol* in the natural, *re* in the soft, *ut* in the hard hexachord. This, then, is *G-sol-re-ut* (*g*), and is thereby distinguished from G *ut* (G) at the bottom of the scale. If we draw out all the notes in the ancient music, from G to *e''*, and set all the seven hexachords against them, marking the *hard hexachord* and all its repetitions as I., the *natural*

hexachord as II., and the *soft hexachord* as III., we arrive at this result:—

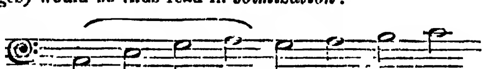
						.	la
d'',						la	sol
c'',						sol	fa
b♮',						.	mi
b♭',						fa	
					la	mi	re
g',					sol	re	ut, I_3.
f',					fa	ut, III_2.	
e',				la ·	mi		
d',			la	sol	re		
c',				fa	ut, II_2.		
b♮,				mi			
b♭,	. . . . . .	.	fa				
a,	. . .	la	mi	re			
g,	. . . .	sol	re	ut, I_2.			
f,	. . . .	fa	ut, III.				
e,	. . la	mi					
d,	. . sol	re					
c,	. . fa	ut, II.					
B,	. . mi						
A,	. . re						
G,	. . ut, I.						

But all this terrible array of names does not differentiate the notes completely; for in the whole seven hexachords there are three notes called *B-mi* (B♮), two notes called *B-fa* (B♭), and two each of *E-la-mi*, *F-fa-ut*, *G sol-re-ut*, and *A-la-mi-re*. In fact C and D are the only notes accurately distinguished throughout. *C-fa-ut* is known from *C-sol-fa-ut*, and both from *C-sol-fa;* and the like occurs with the notes D.

While the melody remained in one hexachord, the notes of that hexachord were always called *ut*, *re*, *mi*, *fa*, *sol*, *la;* but when it passed into another, in modulation, or in going beyond the limits of the six notes, &c., the names of the *new* hexachord were substituted. This passage (an unlikely one to have been written in the dark ages) would be thus read in *solmization*:—



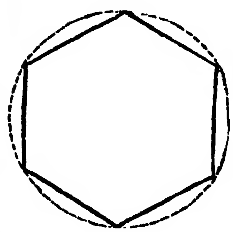
Hexagonal Prism.



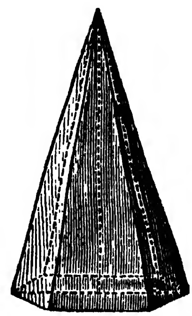
Solmization is the art of sorting out the notes of an ancient melody into their proper hexachords, so that they receive their just *sol-fa* syllables. Only in regarding music in this way can the older music, even as late as Palestrina, be understood. For where we write in musical IMITATION and give the phrase first heard in the tonic to the dominant on its repetition, or *vice versâ*, he imitates from the *hard* to the *natural hexachord*, &c. Certain of his fugue subjects indeed can be answered accurately only in this way; answers according to the rules of modern fugue would quite destroy all responsive character. Confusing as the whole question of hexachords seems at first sight (and it is not nearly so difficult as it seems), it is well worth while attacking if only for the sake of the better comprehension of the beauties of the father of our modern church music, he who stood at the parting of the ways, Palestrina.

HEX'AGON, a plane figure of six sides and six angles, readily inscribed in a circle by taking the radius of the circle as the side of the hexagon. This will give a *regular hexagon;* that is, one of which the angles are all equal and the sides are all equal. For as the figure is to have six equal sides, each side will subtend one-sixth of the circumference of the circle (360 degrees), that is, 60 degrees. Now 60 degrees is the value of each angle of an equiangular triangle, and the six triangles into which the hexagon is divisible by lines which meet at its centre are therefore all equiangular. They are therefore, by the property of equiangular triangles, equilateral; that is to say, the base of each triangle which is the side of the hexagon is equal to the sides of the triangle, which are radii of the circle.

But it is manifest from this that each base may become the side of an adjoining triangle, that is to say, six other regular hexagons of equal size can be drawn round the first hexagon, using one of its sides as one of their own; and these six hexagons will be found to have one side in common between every two of them. Upon constructing the somewhat circular flower-like form suggested, it will be found that absolutely no interstice is left, and that the series can be circularly enlarged without limit and without the slightest waste of space. This gives it a great advantage over nearly all other forms in filling up a given space, only the square and the equilateral triangle (which latter is indeed but a subdivision of the hexagon) sharing this property with it. But if the area contained by an equilateral



Regular Hexagon.



Hexagonal Pyramid.

triangle be 100 square inches, then the area contained by a square, all whose sides added together equal in length the sides of the above triangle, will be vastly superior, namely, over 137 square inches. But both are surpassed by the hexagon, which with six sides whose total length is the same as the four sides of the square, or the three sides of the triangle, will give an area of 150 square inches. With the same total length of sides—that is, with the same amount of material for cell-walls—a hexagonal structure gives half as much space again as a triangular, and exceeds a square structure in this particular by one-eleventh. The bee has learned the wondrous strength, beauty, and economy of the hexagonal form, and accordingly this is the cell-outline adopted in the honeycomb, the structure of which has delighted mankind in all ages, and still charms us with its symmetry and its exquisite adaptability of means to ends. The hexagon forms the base of many elegant solid figures, the chief of which are the hexagonal prism and the hexagonal pyramid.

HEXAG'ONAL SYSTEM, in crystallography, is the third degree of symmetry. It has four axes, three of these are equal in one plane, and inclined to each other at 60 degrees, producing a hexagonal basal section; these are the lateral axes. The principal axis is perpendicular to the plane of these three, but either shorter or longer than the lateral axes. There are six simple forms belonging to this system. The hexagonal pyramid and prism and the dihexagonal pyramid and prism are the four holohedral

forms; from the pyramids are obtained two hemihedral forms, the rhombohedron and the scalenohedron. In this system the hemihedral forms are more important than the holohedral. Tetartohedralism is also frequent, producing in many instances hemimorphism.

HEXAHE'DRON, a solid of six faces.

HEXAM'ETER (Gr. *hex*, six; *metron*, measure) is the most common form of dactylic verse. [See DACTYL.] It consists of six feet, either dactyls or spondees, with no limit in their arrangements, except that the fifth is usually a dactyl and the sixth invariably a spondee. Great part of the beauty of a long poem written in this measure depends on the varied cadences which may be produced by varying the cæsura. Many attempts have been made to naturalize the hexameter in England. The most successful are Clough's "Bothie of Tober-na-Vuorlich" and Longfellow's "Evangeline." But even these fail by the too great paucity of dactylic feet.

HEX'APLA (Gr., the plural of *hexaplous*), which means sixfold, was an edition of the Scriptures of the Old Testament prepared by Origen, which exhibited in addition to the original Hebrew text six Greek versions in as many parallel columns—namely, the Septuagint, that of Aquila, that of Symmachus, that of Theodotion, one found at Jericho, and one found at Nicopolis in Epirus. It also comprehended a seventh version of the Psalms. The Hebrew text was besides given both in Hebrew and in Greek characters; so that, properly speaking, there were eight columns in all, whence the work is sometimes called Origen's Octapla. Only some fragments of Origen's Hexapla remain, which have been collected and published by Montfaucon under the title of "Origenis Hexaplorum quæ supersunt" (two vols. folio, Paris, 1713).

HEX'HAM, a market-town of England, in the county of Northumberland, 20 miles west from Newcastle and 296 from London by the Great Northern Railway, is situated on an eminence near the south bank of the Tyne, a little below the junction of the North and South Tyne. It consists of several streets, the principal of which are tolerably wide, but the rest are generally narrow. There is a bridge over the Tyne of nine principal and three supplementary arches to allow passage to the waters in time of floods; a suspension bridge crosses the South Tyne near the town. In the twelfth century the Archbishop of York established a priory of regular canons of St. Austin here, and the most important building is the old priory church, now used as a parish church. It is a cruciform building with a central tower; the style is Early English, and it has recently been restored. There is an ancient crypt, supposed to be part of the original Saxon church which preceded the priory. At the west end of the church are the remains of the monastic buildings; the refectory is yet entire, and is occasionally used as the room of entertainment; it is very spacious, and has an oak roof. Hexham has several dissenting places of worship, and a town-hall and corn exchange, in the Italian style, was built in 1866. Gloves and tan-leather goods are made in large quantities, and there is also an iron-foundry. In the neighbourhood are large market gardens for the supply of Newcastle. Near Hexham was fought the great battle in May, 1463, which completed the triumph of Edward IV. over Henry VI. The population of the town in 1881 was 5919. At a short distance from Hexham is the Roman Catholic college of Ushaw, built in 1859.

HEX'YL or **CAP'ROYL** is the radical of hexylic or caproic alcohol. The formula is $C_{12}H_{26}$. It is obtained from œnanthylic acid ($C_7H_{14}O_2$) by electrolysis. It is a colourless oil, boiling at 202° C. (395° Fahr.) It is found in fusel-oil, and in the oils from petroleum and coal tar. It can also be obtained from mannite, and stands in close relation to this and the other sugars. *Acetate of hexyl* ($C_8H_{16}O_2$) boils at 156° C. (312° Fahr.) *Hexylic alcohol* ($C_6H_{14}O$) boils at the same temperature as the acetate. *Hydride of hexyl* (C_6H_{14}) is found in the oils from petroleum and from Boghead and cannel coal. It is a fragrant oil, boiling at 68° C. (154° Fahr.) Hexyl combines with chlorine and iodine, forming hexyl chloride ($C_6H_{13}Cl$) and hexyl iodide ($C_6H_{13}I$).

HEX'YLENE (C_6H_{12}) is a very light hydrocarbon, of disagreeable odour. It boils at 70° C. (158° Fahr.) It has a strong affinity for bromine, combining with great violence, and forming the bromide of hexylene ($C_6H_{12}Br_2$).

HEY'NE, CHRISTIAN GOTTLOB, born of extremely poor parents, at Chemnitz, in Saxony, in 1729, studied at Leipzig, and distinguished himself as a classical scholar. Heyne was appointed to the chair of poetry at Göttingen in 1763. The department to which Heyne particularly applied himself was that of classical criticism and the illustration of the writings of the ancients, by showing how they ought to be studied with reference to the manners and character of their respective ages. He published his ideas on these subjects in his notes to the "Bibliotheca" of Apollodorus, and afterwards in numerous dissertations inserted in the *Transactions of the University of Göttingen.* Heyne published editions of Homer, Pindar, Diodorus Siculus, Epictetus, Virgil, Tibullus, Pliny, &c., all enriched with ample commentaries, and most of them several times republished. His essays on the history of ancient art, and his disquisitions on ancient history, are of the highest value. His industry was simply prodigious. Heyne died at Göttingen at an advanced age, in July, 1814. Carlyle has a splendid essay on Heeren's "Life of Heyne" (his father-in-law), which is probably more valuable than the "Life" it illustrates.

HEY'WOOD, a rising town in Lancashire, on the Lancashire and Yorkshire Railway, 199 miles from London. The inhabitants, who number 22,979, are principally engaged in the cotton manufacture. The extensive growth of the place is due to the working of coal in the vicinity, and the consequent establishment of large mills and factories.

HEY'WOOD, JOHN, one of our earliest dramatic writers, lived in the first half of the sixteenth century. He was a favourite at the court of Queen Mary, but in the reign of Edward VI. he was accused of plotting against the government. He retired to the Continent on Mary's death. He was a stanch Catholic, quite opposed to Protestantism, and died about 1565, at Mechlin. Heywood's dramatic pieces "may properly and strictly," says Mr. Collier, "be called interludes—a species of writing of which he has a claim to be considered the inventor." The earliest of them, "A mery Play between the Pardoner and the Frere, the Curate and Neybour Pratte," was not printed till 1533, but must have been written before 1521. In Dodsley's "Old Plays" will be found his "Play called the Foure P.P., a new and a very mery Enterlude of a Palmer, a Pardoner, a Potycary, a Pedlar." Among other productions bearing his name was a posthumous volume of "Woorkes" (1576, 4to), which contains proverbs in verse and 600 epigrams. In respect of them, and to distinguish him from a later play-writer, Thomas Heywood, he is not unfrequently called the Epigrammatist.

John Heywood's son, Jasper Heywood, translated much of Seneca, &c., was a contributor to the celebrated *Tottel's Miscellany* and to the "Paradise of Dainty Devices."

HEY'WOOD, THOMAS, a well-known dramatist who lived in the reigns of Elizabeth, James I., and Charles I. Of all his pieces about twenty-four are left, of which "A Woman killed with Kindness," published in Dodsley's collection, is much admired. It may be perhaps pronounced to be, if we except those of Shakspeare, the most pathetic play in the English drama.

HEZEKI'AH, the twelfth King of Judah, and one of the ablest and best of its rulers, son and successor of Ahaz, ascended the throne at the age of twenty-five, in the year

722 B.C., according to the latest chronology derived from the Assyrian inscriptions. Unlike his father, Hezekiah was most earnest in his zeal for the worship of Jehovah, and the commencement of his reign was marked by the destruction of the idols that had hitherto been worshipped, the removal of the high places, and the reintroduction of the worship of the temple on a scale of great splendour. He was successful in a war against the Philistines, and, relying upon the assistance of Egypt, he ventured to refuse the tribute previously paid to Assyria. This appears to have led to an unsuccessful invasion on the part of Sargon, the successor of Shalmaneser IV., and Hezekiah profited by the interval to complete extensive fortifications and engineering works for the defence of Jerusalem. When, however, Sargon was succeeded by Sennacherib, and the latter directed an expedition against Egypt, Judea was invaded by him, and the capture of all the fortified cities except Jerusalem led Hezekiah to sue for peace and to consent to pay an enormous sum by way of ransom. The truce thus obtained was broken by the Assyrian monarch on his return from his unsuccessful war against Egypt, and the surrender of Jerusalem was demanded. Strengthened by the word of the prophet Isaiah, the king firmly refused to yield, and ultimately "an angel of the Lord" slew in one night 180,000 men of the Assyrian army, and Sennacherib was obliged to retreat. The secondary cause assigned for the destruction of the invaders has been assigned to an earthquake and to a sudden attack on the part of the Egyptians; but most commentators accept the explanation of Josephus, and attribute it to a pestilence. The illness of Hezekiah and his miraculous recovery, together with his act of imprudence on the occasion of the visit of the ambassadors from Merodach-Baladon of Babylon, appear to have taken place previous to this invasion of Sennacherib, and the remainder of his reign seems to have been peaceful and prosperous. He died in 688 B.C., and was succeeded by his son Manasseh. His reign was marked by the utterances of the prophets Isaiah, Micah, and Nahum, and the king himself appears to have been a patron of literature and likewise a poet. (See Prov. xxv. 1, and Isaiah xxxviii. 10-20.)

HIBERNA'TION is the term used to indicate the winter sleep of certain warm-blooded animals. As the season approaches the temperature of their blood is lowered, and they gradually pass into the hibernating lethargy. The hedgehog, the bear, and the bat furnish examples. During hibernation the animal takes no food, breathes only at comparatively long intervals, has its heat diminished, and all its vital functions reduced. In warm dry climates during the hot season, many animals fall into a similar state of torpor, which is then known as *æstivation*. Hibernation in its simplest form is only an intensification of the ordinary phenomena of sleep. Dr. Marshall Hall has laid down the principle that the more respiration is reduced the greater will be the irritability of the muscular fibre. Hibernating animals before retiring for their long winter sleep become very fat. Some animals, as the squirrel and dormouse, which undergo incomplete hibernation, lay up a store of food and awake at intervals to partake of it.

Some fishes æstivate. Both hibernation and æstivation obtain among amphibians and reptiles. Many molluscs share in this phenomenon, the best known instance being land-snails. Some insects both in the larval and perfect state undergo the condition of hibernation.

HIBER'NIA. See IRELAND.

HIBIS'CUS, a genus of plants of the order MALVACEÆ. The species, about 150 in number, of this genus are chiefly herbaceous, though of a large size, but a few are perennial and arboreous. They abound in the hot parts of Asia and America, and also in Africa and the tropical islands. A few extend into Europe, North America, and the Cape of Good Hope. The species are remarkable, like the family to which they belong, for abounding in mucilage, and for the tenacity of the fibre of their bark, whence several are employed for many economical purposes in the different countries where they are indigenous.

The abundance of mucilage in some of the species renders them useful as articles of diet, as the unripe fruit of *Hibiscus esculentus*. In the tropics the pods are known under the names of Ochro, Gobbo, &c.; they are used on account of their mucilage to thicken soups; in some places the leaves are cooked as a pot-herb. So in India *Hibiscus longifolius* is similarly employed, and much approved of by many Europeans. The calyxes of *Hibiscus Sabdariffa* as they ripen become of a red colour and are pleasantly acid, whence in the West Indies the plant is called red sorrel. The calyxes are employed there, as well as in India, for making tarts; and a decoction of them, sweetened and fermented, makes a cool and refreshing drink, much used in the West Indies. Sabdariffa is the Turkish name for the plant. The leaves of *Hibiscus rosa-sinensis* (the "China rose" or "shoeblack plant") are used in the East as an emollient and slight aperient. The petals are astringent, and when rubbed on paper communicate a bluish-purple tint, which is used as a substitute for litmus-paper; they are also used in Java for blacking shoes, and by women in China to dye their hair and eyebrows. In India an infusion of the petals is given as a demulcent refrigerant drink in fevers. Garlands of the showy flowers are used in China on all festive occasions. *Hibiscus Abelmoschus* is so called from *hab-al-mooshk*, the Arabic name of its musk-scented seeds; it was formerly known as *Abelmoschus moschatus*. Its seeds are added to coffee in Arabia, and are in India employed as a cordial medicine.

The species of Hibiscus are chiefly useful for the tenacity of their fibre, and hence several are employed in rope-making. Thus *Hibiscus cannabinus* is cultivated everywhere in India in the rainy season for this purpose. Its fibre is sometimes imported into Europe as a substitute for hemp or jute, and is therefore called Indian hemp or bastard jute. It is remarkable for strength rather than for fineness, a line breaking, in Professor Royle's experiments, at 190 lbs. Its acidulous leaves are eaten by the natives. In the island of Tahiti rope and string are manufactured from the bark of *Hibiscus tiliaceus*, which is also made into matting of a white colour and of different degrees of fineness. This species is common in many of the Pacific Islands. Seemann, in his "Flora Vitiensis," says—"In most countries the fibre of this species is extensively used for cordage, but in Fiji the chief use made of it and that of the foregoing species (*Hibiscus tricuspis*) is for women's *liku*, a dress consisting of a number of fringes attached to a waistband. The bark of these trees is stripped off, steeped in water to render it soft and pliable, and to allow the fibres to separate. The fibres are either permitted to retain their original whiteness, or they are died yellow, red, or black. The liku worn by the common women consists always of one row of fibres, all of the same colour; while those worn by ladies of rank are often composed of two or three rows or layers (flounces), every one of which exhibits a different colour." Almost all the species possess sufficient tenacity of fibre to be used for cordage, whips, &c.

All the species deserve cultivation as ornamental plants, either for the greenhouse, stove, or flower-garden; though for growth out of doors they are not so suitable, as they bloom late. They grow best in a mixture of loam and peat. *Hibiscus syriacus*, a native of Syria and Carniola, is a hardy deciduous shrub, from 6 to 8 feet high, with three-lobed leaves. It was introduced in 1596. There are many varieties of the large showy flowers, single and double, in colour white, yellow, rose, purple, violet, and variegated, all with a darker-coloured spot at the base of each petal. This species thrives well in any good moist soil with protection in winter, and cuttings root readily in

sand under a glass. *Hibiscus roseus* is a hardy herbaceous perennial, from 6 to 8 feet high. It is a native of North America, but naturalized in the south of France, whence it was introduced in 1827. The flowers are very large, pink or purple, with a darker centre. *Hibiscus Trionum* is a hardy annual, introduced from Italy in 1596. It is a native of the Mediterranean region, Asia, Australia, and South Africa. The leaves are palmate, and the flowers yellow with a purple centre. The genus is distinguished by an outer calyx or involucel of several parts, a staminal column bearing anthers on the outside but not at the top, and a five-celled ovary with several ovules in each cell; the style has five spreading branches with dilated stigmas.

HIC'CUP or **HIC'COUGH** is the name given to a spasmodic movement in the throat caused by some internal derangement of the stomach. It is generally supposed that the movements concerned in the production of hiccup consist of a sudden spasmodic descent of the diaphragm accompanied by a spasmodic closure of the glottis when a breath is taken, and the incoming column of air striking against the partially closed glottis causes the characteristic noise. Usually hiccup gives rise but to slight inconvenience, and generally passes off in a short time of itself; but it may persist for hours, and cases have been known where it has lasted for days. The methods commonly adopted to cut short an attack of hiccup are the taking of a deep inspiration and holding the breath as long as possible, counting 100 without drawing breath, or running up several flights of stairs. Drinking a tumbler of cold water will sometimes give relief, and so will the pressure of a belt drawn round the waist. In obstinate cases the use of sedative or stimulating medicines may be required, and ammonia, camphor, chloroform, musk, or the valerianate of zinc may be resorted to. For the distressing hiccup which often follows over-indulgence in alcoholic liquors five-drop doses of the tincture of nux vomica, or ten-minim doses of the tincture of capsicum, given every hour for three or four hours, are excellent remedies.

HICK'ORY (Carya) is a genus of valuable timber trees containing ten species, natives of North America, of which one extends to Mexico. The genus is a near ally of the walnut, which has a much greater range, extending through North America, Mexico, West Indies, Europe, and Asia. The male flowers are in catkins, with from three to ten stamens in each. The female flowers occur, a few together, at the ends of the twigs. The fruit is a drupe like the walnut, but the outer shell (exocarp) splits off from the nut (endocarp, inclosing the single seed) by four valves.

The hickory is like the walnut in habit, with large pinnate leaves, and the species present great variety in appearance. The trees are handsome, and the foliage rich in its colouring, so that they are well adapted for planting in parks and pleasure-grounds. The wood is smooth, close, and hard, qualities which render it very valuable in the arts, though for building purposes it is not so useful, as it does not bear exposure to the weather. The nuts are excellent, and probably could be improved by cultivation.

The Shellbark Hickory or Shagbark (*Carya alba*) can be readily distinguished by the shaggy bark, which peels off in long narrow strips; it has large leaves with five leaflets, and a large edible nut with a deeply grooved husk. It often reaches a height of 80 or 90 feet. The wood is more elastic, and splits more easily than the wood of the other species. The Mockernut Hickory (*Carya tomentosa*) is, like the shellbark, a fine stately tree. The leaves are downy, with from seven to nine leaflets; they have a resinous odour, which is also found in the husks. The nut is good, but the shell is very thick and hard. The Pignut Hickory (*Carya porcina*) has leaves with three, five, or seven narrow leaflets, a small thin-shelled fruit, and a hard nut. The kernel at first tastes somewhat like the hazel-nut, but afterwards changes to a disagreeable bitter. The wood of the best varieties has in even greater perfection than the other species the useful qualities of hardness, tenacity, and weight. The trunk is sometimes 3 or 4 feet in diameter, whereas the shellbark and the mockernut are not often more than 2 feet in diameter. Bitternut Hickory (*Carya amara*) has small, slender, ash-like leaves, with from seven to eleven narrow serrated leaflets. The fruit is small, with winged projections at the upper part of the fruit-seams of the husk; the nut is thin-shelled, with a bitter kernel. It is the most graceful of the species, and rises to a height of 60 or 70 feet. The Pecannut Hickory (*Carya olivæformis*) has long leaves with thirteen or fifteen ovate serrate leaflets. The shell of the nut is smooth and thin, and the kernels have a very agreeable taste with a delicate flavour. The fruit would probably be much improved by cultivation. The wood is coarse-grained, but not so strong or durable as in some of the other species. The Water Bitternut Hickory (*Carya aquatica*) is only 40 or 50 feet high, with smaller leaves than the last. The nuts are small and angular, and the kernels are very bitter. The wood is inferior to that of other hickories. The word *hickory* is an Indian name for some of the species; the botanical name *Carya* is the ancient Greek name for the walnut.

HI'DAGE, an ancient tax of 2*s.* on each hide of land, really the obnoxious Danegeld of Ethelred II. under a new name. It had risen to 6*s.* under the Conqueror, and its abolition had been repeatedly promised. Henry II. did abolish it, but in 1163 imposed it under the name of *hidage*. Its name changed to *carucage* (caruca, of 100 acres) in the time of Richard I. The *hide*, under the Norman kings, was about 100 acres, and as in Ethelred's time it was little over 30, the Conqueror's taxation was only in appearance heavier than Ethelred's.

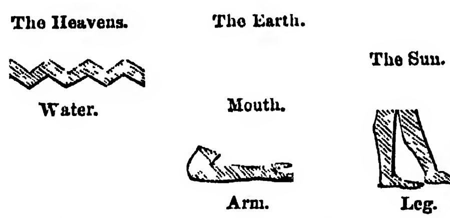
HIDDEN FIFTHS, in the progression of parts in musical composition, are forbidden in many circumstances. See CONSECUTIVES.

HI'ERARCHY, literally "a sacred government," and generally applied to the whole ecclesiastical establishment of a church in all its gradations and orders. The word is strictly applicable only to episcopal churches, such as the Roman Catholic and Anglican, in each of which the hierarchy consists of bishops, priests, and deacons. These constitute what is commonly called the hierarchy of divine right; while those offices which are established solely by ecclesiastical ordinance, such as primates, patriarchs, metropolitans, cardinals, archdeacons, &c., are distinguished as the hierarchy of ecclesiastical right or jurisdiction. The so-called "celestial hierarchy" of Dionysius the Areopagite—the account, that is, of the mediæval conception of the orders of angels and the divisions of heaven—is described under DIONYSIUS.

HIÈRES. See HYÈRES.

HIEROGLYPH'ICS, a compound Greek word meaning "sacred engravings," generally applied to the representations of animal and other forms sculptured on the monuments of Egypt, by means of which the Egyptians expressed their language. The ancient Greek authors call this mode of writing *hieroglyphic* or *hierographic*, and attribute its invention to Thoth, the Egyptian Hermes. According to our best authorities, it is the most ancient mode of writing known to mankind. Obelisks and buildings covered with hieroglyphics still exist in Egypt which are plausibly alleged to be not far short of 5000 years old (about 3000 B.C.), thus distancing the CUNEIFORM by full 1000 years in antiquity. It was called by the Egyptians *Neter tu*, or "sacred words," and was particularly used in all inscriptions relating to the gods, temples, and public events. Above 1000 different symbols appear on examination of the monuments to have been employed, and observations continue further to augment their number. They are arranged with great precision on the monuments, generally in horizontal or vertical lines, with all the animals

and symbols of the same inscription facing in the same direction, whether to the right or to the left; sometimes, however, they are placed in the area or field, and dispersed among the figures or scenes they are intended to illustrate. The animals always face the reader. If the line is to be read from the left, the animals face the left, and *vice versa*. The direction of the reading was left to the chance of artistic effect. Hieroglyphics have been divided into six classes:—(1) Sculptured and not painted; (2) those which are sculptured and painted; (3) *linear*, or drawn in outline; (4) drawn in outline and painted; (5) *polychrome*, or those painted with many colours; (6) *monochrome*, or those painted in one colour. Those carved on stone are generally executed in a peculiar kind of sculpture called *cavo rilievo*, the whole figure being below the surface, but in relief, as it were a bas-relief resting upon a lower level, sunk into the mass of stone; but sometimes in ordinary bas-relief, often coloured in masses (polychrome), sometimes simply linear. Specimens of polychrome hieroglyphics, both Egyptian and Mexican, are given in the Plates under ALPHABET. There can be no doubt that the colours were at first applied in close imitation of nature, and varied according to the individual interpretation of nature by each artist, as in the rude picture-writing of the Mexicans. But we have no monuments of the Egyptian system in that early stage, and we find their earliest painted hieroglyphics, which cover the palaces, temples, and tombs, receiving their different colours according to a settled conventional and somewhat arbitrary system, of which the following examples will afford a sufficiently distinct idea. The character in the form of a canopy, which represented the heavens, was coloured blue; the next character, with the upper side undulated, which represented the earth, was coloured red. The sun is always



red, with a yellow border. The character which represents water is coloured blue or bluish-green. The flesh of men is generally coloured red, and that of women yellow. Portions of the human form, the mouth, the hand, the arm, the leg, are invariably red; flowers, fish, animals, and insects are of simple tones, suggested by their natural colouring, without shading; but in inferior works sometimes they are only green and blue. Wooden objects are nearly always coloured with a pale orange or buff; bronze utensils, green; and blue, with few exceptions, is generally reserved for geometric forms, plans of edifices, &c. The linear hieroglyphics are drawn with a carbonaceous black or a vermilion red ink on papyri, linen, slices of stone, wood, and other materials.

Hieroglyphics appear in use on the walls of the earliest tombs, and even scrawled on the blocks of stone of the great pyramid built by Cheops, and they continued to be employed till the time of Caracalla, during a space of almost 3000 years, latterly in the modified form called hieratic, but subsequently were superseded by a more cursive and easily written form called the Demotic, and finally, on the triumph of Christianity, by the modern Coptic. Crude notions of the nature of the hieroglyphs prevailed till Dr. Young, in 1818, first gave out the idea that they were used as sounds in royal names. In 1808 the learned Quatremère succeeded in proving that the comparatively modern COPTIC [see under article COPTS] represented the ancient unknown Egyptian as modified by time. Henceforward scholars looked for a key to hieroglyphics through the Coptic—before that time no tenable theory as to the nature of the language had been known. Dr. Young's theory was based upon the famous trilingual inscription of the "Rosetta stone," a block of black basalt for ages buried underground, and dug up near Rosetta during the French occupation of Egypt in 1799, passing with the country into the hands of England. Engraved on it were three inscriptions, one of them in Greek; and in the Greek copy it was said that the inscription was ordered, for the better preservation of it, to be inscribed in hieroglyphic and in demotic as well as in Greek characters. Armed with this key, Young attacked the hieroglyphics on the basis of the Greek text; selecting first a cartouche or oval line which he guessed might contain the king's name (the cartouche marked K in Plate IV.), and taking the mat-shaped figure as P (as in the "Alphabet," Plate III.), the semicircle as T, the lion as L, the forked figure ("a hole") as M, and the crook as S, he got the letters PTLMS, or adding in the vowels, PTOLOMAIOS—the rest proving to be a title. This was not mere guesswork; for, as said in Plate III., "mat" in Coptic is *presh* or *phresh* with initial P, "lioness" in Coptic is *laboi* with initial L, and the T M S, in like manner, are the initials of the Coptic words for "semicircle," "hole," and "crook." Once started on this fruitful way, discovery, though slow, was sure. The characters forming the name of Cleopatra (Kleopatra), for instance, can all be traced to their respective origins. The name (see Plate IV., letter I) is read in the following manner, beginning at the top:—The uppermost character, the triangle, is to be read as K, the lion (*laboi*) as L, the figure  as O, the  as P, the eagle (*ahom*) as A, the hand (*tot*) as T, the  as R, and the eagle, repeated, as A; the semicircle is one of the marks indicating a proper name, and the egg denotes that the name is that of a female sovereign. Thus we have KL(E)OPATRA. (The inscription on the Rosetta stone was a mere decree of an assembly of Egyptian priests, in honour of Ptolemy, of no interest whatever in itself.) Later, the removal by Bankes of a small obelisk from Philœ in 1822, which contained a bilingual inscription, enabled Champollion to compare the names of Cleopatra and Ptolemy, when it was seen, from the recurrence of the same hieroglyphics in the same places, as if they were used as sounds, that this was their true employment, and that the signs in this inscription were purely alphabetic, not syllabico-alphabetic. By an extension of the decipherment, the names and titles of the Ptolemies, Roman emperors, and native monarchs were readily discovered. Many of the details of these explanations have, it is true, since been found to be incorrect; but in their general scope they are accurate, and the merit of the discovery is not altered.

Since the time of Champollion, who published a grammar in 1836, and "Dictionary of Hieroglyphics" in 1841, the study has been pursued by Rossellini, Salrolini, Leemans, Lepsius, Brugsch. De Rougé, Birch, Goodwin, Layard, Bunsen, Poole, and others. The greatest present authority is M. Maspero, who made his residence permanently in Egypt.

The general result of all these inquiries has shown that all hieroglyphic inscriptions, from the most remote to the latest periods, consist of two classes of characters—the first, the most ancient and sacred class, called by the Egyptologists *ideographs*, or symbols representing ideas, not sounds; and the second of later date, *phonetics*, or hieroglyphics employed simply as letters of the alphabet. Many hieroglyphics serve for each letter, as will be more fully shown later on in this article.

Ideographs include among them many purely iconographic

or *portrait* characters, such as delineate the positive forms of objects and represent the idea of those objects themselves, and nothing further, like the annexed examples:—

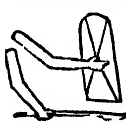
Altar. **Star.** **Propylon or great door.** **Moon.**

The Greeks termed this class of hieroglyphics ἱερογλυφικα κατα ΜΙΜΗΣΙΝ, as being a method of expressing an idea or thing by simple imitation. Such positive signs became, under certain circumstances, symbolical, by a mode of symbolism which Champollion terms *metonymic;* that is, the cause was painted for the effect, or the effect for the cause, or the instrument represented the work done by it; thus,

A Month. **Night.**

a month was represented by the moon with the crescent downwards, as it appears towards the end of the Egyptian month, which was lunar. In a more metaphorical manner, the palm-tree denotes a year, because it is said that this tree puts forth one branch every month. Night is represented in this class of characters by the conventional sign expressing the heavens, a kind of canopy, to which stars are added.

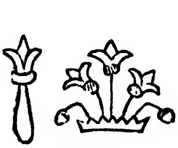
Another class of characters was rendered symbolic by a different method, termed by Champollion *synecdoche*, in which only a part of the whole figure being drawn or written, the *action* was understood, instead of the actual figure; thus two arms, one with a shield and the other



Combat.

Hierographer.

with a pike, represented a combat, as indicating both attack and defence. Another and more purely symbolic class of characters was one in which the quality or locality of an object was signified instead of itself; for instance, a hierographer, or sacred writer, was expressed by the image of a jackal, either alone or placed over the door of a temple,



Water-lily.

Papyrus.

because it was the duty of the sacerdotal functionary to be always watchful over sacred things, like a faithful dog. A kind of water-lily, generally considered the lotus, signifies

The White Crown of Upper Egypt. **The Red Crown of Lower Egypt.**

Upper Egypt, while the papyrus, with its tuft of thread-like inflorescence, denoted Lower Egypt. Or these grand divisions of the country were also expressed by the different crowns worn by the sovereigns in the respective regions.

Finally we reach the pure ideographs, or symbols representing ideas. Such, for example, are the falcon, which represents sublimity, on account of its elevated flight; the fore part of a lion, which indicates pre-eminence; the queen bee, expressing regal power; or the vulpanser or goose of the Nile, which represented a son, because this bird is celebrated for its filial affection. The bee, in a similar manner, represents a people industrious and faithful to their king;

The Lion. **The Queen Bee.** **The Goose of the Nile.**

the vulture, maternity; the bull, strength or husband; a stretched-out hand, the action of giving; a hand holding a club, force; an ostrich-feather, truth or justice, from the equality of all the filaments peculiar to this feather. Still more recondite in expression are such ideographs as a calf running placed above the symbol representing water, ex-

Justice. **Thirst.** **Sweetness.**

pressing *thirst;* or a bee and a honey-jar, representing *sweetness.*

But the great body of the inscriptions is composed of phonetics, to the extent of four-fifths at least of each entire text; and they are easily distinguished by their constant recurrence. They are, however, fewer in the total number of signs used for writing than the ideographs. The system in which hieroglyphics become usable phonetically has already been hinted at. It is by using the hieroglyph for the first letter of the name of the figure it represents. Thus the lion stands for L, because L is the first letter of Laboi (lion); water stands for M, since Môou (water) begins with M; and so on. Manifestly, however, since many words begin with M besides Môou there may be many other signs for M than the water sign; and we are not astonished when we find the few sounds of the Egyptian alphabet represented by about 150 distinct signs. The lapidary inscriptions are almost all religious, historical, or sepulchral. Even verse or rhythm has been found, and the expressions are often flowery with Oriental imagery, antithesis, and metaphor.

The two classes of hieroglyphics, the ideographic and the phonetic, are used very cleverly in such a way as that the former extends the meaning of the latter, and the latter gives precision to the former. Plate I. contains the usual figures of the Egyptian gods as represented in hieroglyphics, that is, representations of their statues. Plate II. gives the symbols or ideographs of the same gods, that is, representations of their qualities; and each Plate gives also a small selection of some of the most usual groups, chiefly ideographic, but partly also phonetic. The symbols are translated on the Plates. Plate III. gives a few of the letters of the phonetic alphabet, with a complete view of the hieroglyphics used for each of those given. Over each division are placed the Hebrew, Phœnician, Coptic, Greek, and Roman characters for the sound. The hieroglyphics follow, in four rows, showing several varieties for each letter. The first row gives the finished hieroglyphic form, the second the linear hieroglyphic, the third the hieratic, the fourth the demotic; and few can fail to remark how very closely the Hebrew letter approximates to the

hieroglyphic character in one or other of its forms. The Phœnician shows its kinship to both Hebrew and Egyptian, and the Greek letters readily derive themselves from the Phœnician. The derivations are far more apparent upon a large consideration than when limited to the few selected letters, chosen also from other motives. The hieratic, which is strictly limited to books (hieroglyphics being the language of stones or of books using the sculpture-tongue), strikes one at once with its great likeness to Chinese, especially when seen in large masses. But this is probably a mere coincidence, without meaning.

Among the Plates, under the heading NUMERALS, will be found one showing clearly the derivation of our system of number from Egypt. The curious mode of counting therein shown, copied from hieroglyphic monuments, is most interesting from its clearly decimal character. The special hieratic characters for the days of the month, distinct from ordinary numbers, are also given. Our own figures appear in their rudimentary stage, carried a step onward still in the cursive demotic, as shown in the same Plate. Plate IV. of the present series gives a number of titles of honour, names of kings, &c., showing incidentally the highly decorative effect of hieroglyphics as a mode of

Banner of Thothmes the Great.

royal inscriptions. Above is a sketch of a fine banner of the great Thothmes, an excellent example of the magnificence attainable.

Besides the Egyptians, the ancient Ethiopians also carved hieroglyphics on their pyramids and public monuments. At Nineveh, Koyunjik, and even in the isles of the Greek Archipelago, objects have also been found with hieroglyphical inscriptions not in the Egyptian language—perhaps unmeaning imitations, like the obelisks erected by the Roman emperors, and ornamented with fanciful figures in the Egyptian style, from an artist's point of view.

The term hieroglyphic has also been applied to the writings and paintings of the ancient Mexicans, by which they depicted the various occurrences of life. A symbolical system of pictorial writing prevailed in Central America and Yucatan before their conquest by the Spaniards. [See ALPHABET.] Sometimes the Mexican manuscripts were

Mexican Book of Hieroglyphics.

done up in rolls, but frequently like a folding screen, with a more solid board at each end, so that when folded up they presented the appearance of a modern European book. This form is much more convenient than that of the rolls of Greek, Egyptian, and Roman MSS., as it enables the reader to look at one page at a time, thus presenting nearly the same advantages as the leaves of a modern volume. The first Spanish archbishop of the newly-acquired territory, considering the ancient archives of Mexico, preserved in these interesting folded MSS., to be nothing better than idolatrous books of magic, caused them to be collected in vast numbers, especially from the great seat of Mexican learning, Anahuac, and burnt them in a "mountain heap," as the chroniclers of the time have termed it. It is, indeed, a curious fact, that among the few Mexican MSS. which have escaped destruction and been brought to Europe, where they now form the most highly prized rarities of national museums, not *one* has found its way to the national libraries of Spain, where it might be presumed that a splendid collection would have existed.

Astrologers and almanack makers of modern days have applied the word hieroglyphics to the symbolical pictures by which they pretend to show the events likely to happen in the course of the year.

HI'ERON I. succeeded his brother Gelon, as tyrant or ruler of Syracuse, 478 B.C. After the death of Theron, prince of Agrigentum, Hieron attacked and defeated his

Coin of Hieron I. in the British Museum—silver.

Reverse.

son, Thrasydæos, who was soon after expelled by his countrymen. Hieron took Naxos and Catana, and, having driven away the inhabitants from both towns, he replaced them by Syracusan and Peloponnesian colonists. His chariots repeatedly won the prize at the Olympic Games, and his success on those occasions formed the theme of some of the odes of Pindar, who was his guest and friend. Æschylus, Simonides, Bacchylides, and Epicharmos were also well received at the court of Hieron, who was fond of the society of learned men. Hieron died at Catana, in 467 B.C., and was succeeded by his brother, Thrasyboulos.

HI'ERON II., son of Hierokles, a wealthy citizen of Syracuse, and a descendant of Gelon, served with distinction under Pyrrhus, in his Sicilian campaigns. After Pyrrhus had abandoned Sicily the Syracusan troops chose Hieron for their leader, and the senate and citizens ratified the choice, 275 B.C. By marrying the daughter of Leptines, a man of influence among the aristocratic party, he secured their support. Having led the army against the

Mamertines, a band of Campanian mercenaries, whom he defeated, the main body returned to Syracuse, where, through the influence of Leptines, he was proclaimed king, B.C. 270. The Mamertines of Messana, being threatened by Hieron and the Carthaginians, applied to the Romans for assistance. The Consul Appius Claudius marched to Rhegium, and having passed the strait in the night unobserved by the Carthaginian cruisers, he surprised Hieron's camp, routed the soldiers, and obliged Hieron to seek for safety in flight. The consul next attacked the Carthaginian camp with the same success, and this was the beginning of the first Punic War, 264 or 265 B.C. In the following year the Romans took Tauromenium and Catana, and advanced to the walls of Syracuse, when Hieron obtained peace on condition of paying 100 talents of silver and supplying the Roman army with provisions. He punctually fulfilled his engagement, remained faithful to Rome during the whole time of the war, and by his supplies was of great service to the Roman armies. Hieron was included

Coin of Hieron II. in the British Museum—copper.

in the peace between Rome and Carthage, by which his territories were secured to him, and he remained in friendship with both states. The period which elapsed between the end of the first and the beginning of the second Punic wars, from 241 to 218 B.C., was most glorious for Hieron and most prosperous for Syracuse. Commerce and agriculture flourished, and wealth increased to an extraordinary degree. Hieron paid particular attention to the administration of the finances, and issued wise regulations for the collection of the land tax, which remained in force throughout Sicily long after this time. He embellished and strengthened Syracuse, and built large ships. Archimedes lived under this reign. When the second Punic War broke out, Hieron continued true to his Roman alliance. He lived to see the battle of Cannæ, after which his own son Gelon embraced the part of the Carthaginians. Gelon, however, died, not without suspicion of violence, and Hieron himself, being past ninety years of age, died shortly after, 216 B.C., leaving the crown to his grandson, Hieronymos.

HIERON'YMOS, grandson of Hieron II., king of Syracuse, succeeded him on the throne at the age of fifteen (B.C. 216). The court of Syracuse, which under Hieron was orderly and respectable, soon became as profligate as it had been under the younger Dionysius. After the battle of Cannæ, Hieronymos declared war against the Romans, but a conspiracy broke out among his soldiers, and he was murdered, after a reign of thirteen months. On this news a popular insurrection took place at Syracuse, the daughters and granddaughters of Hieron were murdered, and royalty was abolished.

HIERON'YMOS. See Jerome, St.

HIEROPHAN'TES, a name applied to the high-priests of the Eleusinian mysteries, who for many ages were chosen from the family of the Eumolpidæ. The term was also applied to the priests or priestesses who had the care of the sacrifices and sacred things.

HIGH BAILIFF, an officer who discharges ministerial duties, serving writs, &c., in certain liberties and parishes out of the jurisdiction of the sheriff.

HIGH COMMISSION, COURT OF. The origin of the "English Inquisition," a terribly just and popular descriptive name of the celebrated Court of High Commission, lies, as Hallam points out, in the commission granted by Mary in 1557 to certain church dignitaries to inquire into cases of heresy. "But the primary model," he adds, "was the Inquisition itself" ("Constit. Hist." i. 202). The machinery thus established in Roman Catholic interests lay ready to the hand of Mary's Protestant successor Elizabeth, and the great queen, nowhere better pleased than when she was able, without damage to her own character, to avail herself of what had brought odium upon others, promptly utilized it the year after her accession, under the power given her by the Act of Supremacy. But this and other single sittings were only held as heresies or nonconformities required suppression in the queen's eyes. It was not till 1583 that the body was formally constituted a permanent court under the too famous title of the Court of High Commission. Forty-four commissioners were appointed, twelve bishops among them, one bishop and any two others forming a quorum. Blackstone summarizes its duties from the Royal Commission as "to vindicate the dignity and peace of the church by reforming, ordering, and correcting the ecclesiastical states and persons, and all manner errors, heresies, schisms, abuses, offences, contempts, and enormities." These immense powers were used in the most arbitrary way, following the fearful model offered by Spain; but of course stopping short of the sickening horrors of that detestable tyranny. Nevertheless, many hundred clergymen suffered very much through the persecution of the court, which not only ejected them, but pursued them relentlessly with spies into their private life. It was truly a Protestant Inquisition. Any clergyman suspected of Puritanical leanings was haled before the court, and had to undergo a stringent and minute cross-examination upon oath. So vexatious was the procedure of the court, working by spies and informers, and serving as a ready tool for revenge in the hands of unscrupulous enemies, that under Elizabeth's successor, King James I., public complaints were made of it, and finally in 1610 the House of Commons itself presented a formal petition for its abolition. Its pernicious abuse of power was, however, too dear to the court party for it to be suffered to be taken away, and it only fell with the elder Stuarts themselves, in 1641, at the hands of the Long Parliament. James II. made an endeavour to revive it as the Ecclesiastical Commission Court, but met with determined resistance; and the attempt formed one of the articles against James in the Bill of Rights, where it was denounced as "illegal and pernicious" (1689).

This English Inquisition is the worst blot on Elizabeth's reign. All offences by any possibility bearing on matters of church discipline, from heresy to adultery, fell under its authority, and it was supreme. It might fine and imprison without limit. As might be expected, moreover, these dread responsibilities were shirked by laymen, and the real work of the court lay in clerical hands. The result was that the successive archbishops of Canterbury—Parker, Whitgift, Bancroft, Abbot, and Laud—wielded a power which even Wolsey never held, and which no one ever since has held, nor can again hold in England. Half a century of ecclesiastical tyranny broke for ever the power of the English Church for evil. But it was a terrible time while it lasted. Each successive archbishop enforced his own personal views; and while no two were alike, all were equally severe. Men knew not what to profess in order to be safe. Thus Parker instantly deprived a vicar for doubting the entire inspiration of every word in the Bible. Whitgift was a supralapsarian, and thrust his Calvinistic doctrines down the throat of clerics and laity alike. Bancroft reversed this altogether, and fined and imprisoned right and left all who denied the entirely opposite view of

the divine authority of the bishops. Then came Abbot, full of rage against the Erastians, to be succeeded by Laud, a still worse enemy of anyone who opposed Erastianism. From time to time little bands of persecuted men, in Elizabeth's time, escaped as if they had been criminals to the friendly shores of Holland; and after many long years a body of these "Brownist" fugitives from the Court of High Commission set sail from Holland in the *Mayflower* for the barren shores of Massachusetts, in the New World (1620). Later days have affectionately named these exiles for religion's sake the "Pilgrim Fathers." The merchants of Boston, in Lincolnshire, were so generous with their aid that the chief town of Massachusetts was named after them. In 1629 Charles I. granted a charter to the colony, and then began a wholesale Puritan emigration, for Laud was now at the head of the Court of High Commission, and doing his work with such merciless severity as to excite the admiration of the pope himself. Feeling sure that he must be a Roman Catholic at heart, the pope even sent to Laud a cardinal's hat. The best men in the country poured out of it by hundreds and by thousands. The Scotch instituted the Covenant (1638-39), and Charles began, only to abandon it almost at once, what was called the "Bishop's War" against Scotland (1640), his failure in which drove him to call together the Long Parliament. Almost its first act was to dissolve the Court of High Commission and to fling Laud into prison, whence he emerged only to mount the scaffold in January, 1645.

HIGH PLACES (Heb. *Bamoth*), the name given in the Old Testament to certain sacred places where the worship of Jehovah was celebrated by the Israelites. The tops of hills and the sides of mountains have ever been favourite places for the erection of altars for worship, and many such seem to have been built both by the Jews and the Canaanites. The circumstance that the worship of Jehovah at such altars is strictly forbidden in the Pentateuch (Deut. xii. 11-14, &c.), and yet that the practice was not only universal during the period of the judges and for long afterwards, but that it was performed by divine command in the cases of Gideon and Manoah, and also without any reproof by Samuel, Saul, David, and Elijah, was until a recent period a source of considerable perplexity, both to Jewish and Christian commentators. Many ingenious solutions of the difficulty were propounded, but the true explanation has been found in the more accurate view of Jewish history, and the date of the commands given in the law discovered by the labours of modern scholars. [See PENTATEUCH.] As many of these high places had been already rendered sacred to the worship of some local deity before they were used for the worship of Jehovah, they offered considerable temptation to the ignorant among the Jews in the direction of polytheism, while to the more rigid worshippers of Jehovah the sacrifices to another deity had made such places impure and polluted. These influences at a late period seem to have led to the abolition of all local sanctuaries in favour of Jerusalem, but this change does not appear to have been fully effected until the reign of Josiah, 634 B.C., in connection with which they are last mentioned. It is, however, a curious and interesting fact that the traditionary belief in the sanctity of such places has survived all changes of dynasty, nationality, and religion, and at the present day there are heights in Palestine which have been resorted to for worship ever since the days of the Canaanites, and are still held in reverence alike by Jews, by Arabs of the desert, and by the different sects of Mohammedans and of Christians.

HIGH-PRIEST, the title given to the chief member or head of the Jewish priesthood. By the law the office was confined to the family of Aaron, and this restriction appears to have been observed, though there was more than one change in the line of succession, until the time of the Captivity, and to have been again revived after the building of the second temple. About 153 B.C. the office passed into the hands of the Asmoneans, at first only a private Levite family, by whom it was retained until the time of Herod the Great. In the period subsequent to this the right of succession was wholly disregarded, and no less than twenty-eight high-priests were appointed during the period which elapsed between the reign of Herod and the destruction of the temple.

The high-priest was distinguished from his brethren by a special consecration and anointing, and peculiar functions were committed to him. He alone was permitted to enter the most sacred part of the temple, the holy of holies, which he did once a year on the great day of atonement, when, as the representative of Israel, he sprinkled the mercy-seat with the blood of the sacrifice, and burned incense within the veil. His official costume was very costly and magnificent, and with the gold and jewels with which it was ornamented it passed to his successor at his death or removal. According to the Rabbins, it consisted of four articles common to all the priesthood—viz. a turban, tunic, girdle, and drawers; and four articles peculiar to the office—viz. a mitre or upper turban, fitted with a gold plate for the forehead and a triple crown of gold, the breastplate of twelve precious stones, the ephod or vestment covering the back and breast, and the robe of the ephod fitted at the bottom with a row of golden bells and pomegranates to give a sound when the priest moved.

The office seems to have had a liberal revenue assigned to it, and the holder was always addressed by his brethren as *Ishi Kohen Gadol*, "My Lord High-priest." In order to provide for accidents, a second officer, called the Sagan, was appointed with the high priest, who officiated during his absence. He is termed in the Old Testament the "second" priest, and the reference to two high-priests (Luke iii. 2) is explained by the fact that Annas was sagan.

HIGH SEAS, a term meaning the open sea, or that which is common to all countries. As a rule, every country has exclusive sovereignty over the sea to the extent of 3 miles from its shore; beyond that distance, and at any part which is more than 3 miles from any other country, is not the property of any particular country, and is technically termed the high seas. The rule as to the sovereignty within 3 miles is strictly observed with regard to fishing, except where special arrangements are made, but does not in any way restrict navigation.

HIGH TREASON is a crime created by Alfred the Great, who declared it "death-worthy." His law of treason was, "If anyone plot against the king's life, of himself or by harbouring of exiles, or of his men, let him be liable in his life and all that he has." To this subsequent decisions gradually added the murder of relatives or of servants of the king, and finally (as in the case of the Despensers and Roger Mortimer) the grasping at the king's administration, &c. This vagueness led to much injustice; and in 1352, in answer to a petition of Parliament, Edward III. caused to be passed the Statute of Treasons, limiting high treason to seven definite offences. These were (1) compassing or imagining the death of the king, the queen, or their eldest son or heir—which includes, of course, in strictness any open act against the royal person, as an act of war, an attempt to seize the king, &c. It was also held to include the crime of the Duke of Norfolk in proposing to marry Mary Queen of Scots, which was alleged to be an open act resulting from his desiring Elizabeth's death in his own mind, and he was accordingly executed on this charge in 1572. (2) Violating the king's companion, eldest unmarried daughter, or eldest son's wife. (3) Levying war against the king in his realm, which would also come under the first article, but is here specified singly. The rebellion is not taken out of the category of high treason by its being levied against the king's ministers and not against himself,

as witness the Earl of Essex's condemnation in 1601. Small acts of rebellion are dealt with not as treasons but as riots, under the Riot Act of 1715. (4) Aiding the king's enemies in his realm or elsewhere. (5) Counterfeiting the king's great seal or privy seal, or (6) his money, including the bringing of false coin into the country; and (7) slaying the chancellor, treasurer, or justice while in the performance of their duties. Further legislation occurred in 1382 and in 1397. Many new clauses were added under the tyranny of Henry VIII.'s later years; but most of these new-fangled treasons were done away with by Edward VI. (1547), and a few still left were finally removed by Mary (1553). But in 1559 Elizabeth, who suffered under a ban of illegitimacy (removed by her father in his will), and who, a Protestant, succeeded to a Catholic queen, found it necessary to add a new form of high treason, namely (8) the calling in question of the queen's title. In 1571 the arrangements for the succession were so ill-received that the queen invented another new offence, (9) to deny the power of the queen and Parliament to limit the succession. In the Act of Settlement (1702), under which our present royal family succeeded to the throne in 1714, it was made high treason to (10) hinder the next in succession under that Act from occupying the throne upon a vacancy, and in 1707 this hindrance was extended to cover the writing or printing of anything contesting the right of that lawful successor.

In 1817 the Treason Act of George III. reduced all these crimes to four—namely, (1) to compass the death, bodily harm, restraint, or dishonour of the king; (2) to levy war, or conspire to levy war, against the king to induce him to alter his measures, or for the purpose of overawing Parliament; (3) to treat with any foreigners for the invasion of the king's dominions; and (4) to write or publish or openly make known an expression of such designs.

Two witnesses to a charge of high treason are required by the Act of Edward VI. (1552), and these must certify to the same act of treason (1695). Copies of the indictment must be given to the accused ten days before trial, with a complete list of the witnesses and jury. This regulation was made in 1708. Further regulations were made in 1800, 1825, and 1842.

In 1848 all the crimes of high treason, except those actually committed against the sovereign, were reduced to the rank of TREASON-FELONY. Finally, the method of death punishment was altered from the brutal "hanging, drawing, and quartering" (the drawing or disembowelling having in many cases taken place during the life of the wretched sufferer) to simple hanging, and the forfeitures for treason were abolished. The punishment of death is thus now the same for high treason as for murder, and is limited to these two crimes.

The ancient law of Scotland in relation to treason differed considerably from that of England. Treason was deemed to be either proper or statutory. Proper treason included crimes committed directly against the sovereign or the state; statutory treason comprehended such acts as, though not proper treason, were, because of their supposed mischief or enormity, punished as such by statute. The punishment was death, forfeiture, and loss of honour and privilege; but it did not involve the revolting details of the English law, and on the whole was much milder. By 7 Anne, c. 21, secs. 1, 23, the English law of treason was transferred to Scotland in its entirety, both as regards punishment and mode of procedure.

HIGH'WAY, a public way over which the right of walking, riding, or driving is enjoyed by every subject of the kingdom. Such a road is commonly called the "queen's highway," not because of any special right or power possessed by the sovereign over the road, but because the rights of the public are secured by the laws of the realm, of which laws the sovereign is the nominal guardian.

There are five kinds of highway distinguished in English law—viz. (1) a foot-way, which may be used by persons walking or running on foot only; (2) a horse-way, for persons passing on horseback, but which may be used by foot passengers as well; (3) a pack and drift way, which is open also to pack-horses and for the driving of cattle; (4) a carriage-way, for leading or driving carts and other carriages, always including a foot and horse way, and usually, but not necessarily, including a drift-way; (5) a water-way, for ships and boats.

A highway is created where the owner of any soil has, by express words or by some act done or forborne, declared his intention that the public shall have the use of a way over such soil; or it may be created by statute under the Inclosure Acts; or by the necessity of things. Whatever may have been the origin of a highway it cannot be destroyed by the owner of the land, for it is a maxim of the law, "once a highway always a highway." This does not apply, however, where an old road has been stopped up or diverted by the substitution of a new one by proper legal authority. Where land is opened for the passing of the public, the latter after a use of a few years acquire a right of way, and where an owner desires to reserve to himself the right of excluding the public, he must do some act to show that a temporary permission only is granted. A common method of preserving the right of the owner is to close the way against the public for one day in every year. In cases where a way is freely used by the public for six or eight years the law presumes a dedication has been made by the owner, and in the case of new streets in towns a shorter period may be sufficient to establish a right of way. It is, however, the privilege of a landowner to give a limited right of way only—as, for instance, to foot passengers and carriages, but not to cattle; or he may prohibit the carriage of particular commodities, such as manure or coals. In the case of a public highway, if any obstruction, such as a gate or wall, be placed upon it, or if a house be built so as to encroach upon it, any passenger has the right to abate or remove the obstruction, and this without notice or ceremony, but no more damage may be done than is necessary for such abatement or removal. The wrong-doer may also be proceeded against by indictment as for a misdemeanour. If any tree, bush, or shrub be planted on a public carriage-way, or within 15 feet from the centre thereof, without the permission of the proper authorities, the same must be removed upon notice being given by the surveyor. In the same way trees or shrubs that overhang the public highway must not be allowed to encroach upon it to the detriment of the public, and the owners may be required during the proper seasons of the year to have such trees or shrubs pruned, under penalty of a fine for non-compliance. Further, it is unlawful for any person to ride or drive upon the footpath of a public highway, or to tether cattle upon it; nor may tents be pitched or games played upon it; no rubbish or offensive matter may be placed within 15 feet from the centre of the road, and the lighting of fires, the firing of guns, pistols, or squibs are alike prohibited. Any such offence incurs the penalty of a fine not exceeding 40*s.*, which may be enforced by summons before justices. Persons owning or occupying land adjacent to a public highway are prohibited from doing anything to the detriment of the public using it, even by practices lawful and right in themselves. Thus no pit or shaft may be sunk or steam engine erected within 25 yards of any carriage or cart way, unless the same is within a house or building, or a sufficient wall or screen is erected; nor may ironstone, limestone, bricks, or clay be burned within 15 yards of any roadway without similar protection. Where a highway has become founderous or impassable owing to the overflowing of a river, the subsidence of land, or any other cause, the public have the

right to pass over the adjacent land, whether it be cultivated or not, so as to avoid the founderous portion, and such use of the land will be no trespass under the circumstances.

The regulation of highways has frequently been made the subject of legislation, and the whole subject was dealt with in 1835 by a statute known as the General Highway Act, 5 & 6 Will. IV. c. 50. In this Act minute rules are laid down concerning many of the more important points connected with the management of highways, and the authorities are designated who are intrusted with their enforcements. This Act still remains in force, subject to the amendments introduced by subsequent legislation, embodied in numerous Acts, of which the more important are 25 & 26 Vict. c. 61; 27 & 28 Vict. c. 101; 41 & 42 Vict. c. 77.

In Scotland the law takes notice of three kinds of roads —*foot-road*, *horse-road*, and *cart or carriage road*. To vindicate the right of the public to use them possession as of right, not by tolerance, must be established for forty years or time out of mind, and it must be uninterrupted. It may be vindicated by any member of the public by a declaratory action. Formerly numerous Acts were passed for creating and maintaining statutory highways throughout Scotland, but these have now been consolidated into one general code, so to speak, by the Roads and Bridges Act of 1878 (41 & 42 Vict. c. 51), to which reference must be made. It may be stated that a "public road" differs from a "highway" in being maintained by no public fund; but in either case it would seem that the property of the *solum* will *in dubio* be held to be in the owner of the ground through which the road passes.

HIL'ARY TERM, a name said to be derived from St. Hilarius, bishop of Poitiers, and now applied to the English law term, during which the law courts hold their sittings at Westminster *in banco*. It commences on the 11th and terminates on the 31st of January.

HIL'DEBRAND, POPE. See GREGORY VII.

HILL, LORD, a distinguished English general, second son of Sir John Hill of Hawkestone, Shropshire, and a nephew of the celebrated preacher, his namesake, was born 11th August, 1772. He entered the army as ensign in the 36th Regiment, and was aid-de-camp to Lord Mulgrave, General O'Hara, and Sir D. Dundas successively.

On the 1st January, 1800, he was appointed full colonel, and was in active service with his regiment in Egypt under Sir Ralph Abercromby. He served in the campaigns of 1809, 1810, and 1811, under the Duke of Wellington, and displayed such great talents as a commander that he was made a G.C.B., and elevated to the peerage in 1814. He commanded a division at Waterloo, and aided in the final repulse of the French; in the *melée* his horse was shot under him, and he narrowly escaped with his life. In 1827 he declined the offer of chief command of the army in India, but succeeded the Duke of Wellington as commander-in-chief of the whole army in 1828. He presided at the Horse Guards until August, 1842, when failing health compelled him to offer his resignation, and her Majesty, in recognition of his long and faithful services, raised him to the rank of viscount. He died at his seat of Hardwicke Grange, Shropshire, on the 10th December, 1842.

HILL, ROWLAND, a preacher of eccentric genius and apostolic zeal, sixth son of Sir Rowland Hill of Hawkestone, was born 23rd August, 1744. Educated at Eton and St. John's, Cambridge, he was ordained in 1774 to the curacy of Kingston in Somersetshire. Having Berridge and Whitfield for his friends he entered upon a course of itinerancy, preaching in villages and paying religious visits to prisons and workhouses. In 1782 he laid the first stone of Surrey Chapel, London, opened it in the following year, and was minister of that favourite place of worship for fifty years. He was one of the founders of the Bible Society, the Tract Society, and the London Missionary Society. He was also one of the earliest and most effective promoters of Sunday schools, and a powerful advocate of vaccination. He was often unable to restrain his drollery in the pulpit, and many anecdotes are told of his eccentricities. His preaching was in a style peculiarly his own. It savoured nothing of art, nothing of the schools, hardly anything of study, but all of nature. He died 12th April, 1833, and was buried under his own pulpit at Surrey Chapel.

HILL, SIR ROWLAND, K.C.B., founder of the system of penny postage, was born at Kidderminster 3rd December, 1795. In 1832 he published his first pamphlet of note, entitled "Home Colonies; Sketch of a Plan for the Gradual Extinction of Pauperism, and for the Diminution of Crime." In it was broached the scheme, often resuscitated since, for the settlement of able-bodied paupers on waste lands, by the cultivation of which the expense of their support would be saved to the state; and the theory was supported by references to the success of a similar experiment in the case of the paupers of Holland and Belgium. After this Rowland Hill was appointed secretary of the South Australian Commission, and aided in founding the colony of South Australia. It was in 1837 that he printed for private circulation his celebrated pamphlet, "Post-office Reform; its Importance and Practicability," and after gathering opinions and suggestions he gave it to the public. The reforms proposed in the pamphlet included in their results increased speed in the delivery of letters, greater facilities for their despatch, and a simplification of the operations of the post-office. But their chief feature was the establishment of a uniform rate of a penny for each half ounce, whatever might be the distance traversed by the letter. He predicted that by the adoption of his suggestions, not only would enormous advantages be bestowed upon the public, but a net revenue of more than a million sterling would be procured from the post-office. Towards the end of 1838 a committee of the House of Commons reported in favour of the plan. On the 12th of July, 1839, a resolution was carried in the House approving of it, and an Act of Parliament embodying it was passed. The founder of the new system was appointed by the Treasury, at a salary of £1500 a year, to superintend the execution of his plans; but after three years his services were dispensed with by the ministry of Sir Robert Peel. A public testimonial to Mr. Hill was proposed in 1844, and resulted in the presentation to him of the sum of £15,000. In 1846, on the resumption of office by the Whigs, Rowland Hill was appointed secretary to the postmaster-general, and in 1854 sole secretary to the post-office. This situation he resigned in February, 1864; but the full salary attached to it continued, on account of his vast exertions in postal reform, and he also received a Parliamentary grant of £20,000. He had been made a K.C.B. in 1860, and was made a D.C.L. (Oxon), in 1864. He died at Hampstead 27th August, 1879, and was buried in Westminster Abbey. A bronze statue of Sir Rowland was erected near the Royal Exchange, London, in 1883.

HIMALAY'A MOUNTAINS (the Indian pronunciation of the word is *Hima'laya*). The Himalayas, literally, "the abode of snow," from the Sanskrit *hima*, frost (Latin *hiems*, winter), and *alaya*, dwelling-place, comprise a system of stupendous ranges with the loftiest peaks in the world. They are (among other names) the *Emodus* of Ptolemy, and extend continuously, in shape something like a scimitar with its blade facing south, for a distance of 1500 miles along the northern frontier of India, from the gorge where the Dibong (the connecting link between the Sanpu of Tibet and the Brahmaputra of Hindustan) bursts through their main axis, to where the Indus, having reached its northernmost latitude, turns and pierces through the same mountains to enter on its southerly course towards

the Arabian Sea. The Himalayas form one of the chief ranges of Asia, and with the Kuen Lun converge towards the Pamir table-land, that mountainous knot whence the Tian Shan and the Hindu-Kush also radiate. With the Kuen Lun the Himalayas have a closer connection, as these two mighty ranges form respectively the northern and southern escarpment of the lofty Tibetan plateau. Owing, however, to the plentiful rainfall on the southern slopes of the Himalayas, to which the rain-clouds are swept direct from the sea, the river system formed thereby is incomparably the more extensive and plentiful. This may account for the serrated character of the Himalayas as contrasted with the sheer wall-like face of the Kuen Lun.

The most comprehensive view of the Himalayan system represents it as composed of three culminating chains, to which the names northern, central, and southern are conveniently applied. The northern chain is naturally divided into a western and an eastern section, the western being known as the Karakorum or Muztagh, and forming, speaking broadly, the water-parting (though not a completely uninterrupted one) between the basins of Lob-Nor and the Indus. The peaks along this section of the Himalayas frequently attain a height of 25,000 feet, and the chief one (which is as yet unnamed, but is distinguished by the sign "K 2" in the records of the Great Trigonometrical Survey) is 28,278 feet high, being second in altitude to Mount Everest. The southern slopes of the Muztagh range in its northern portion are clothed with enormous glaciers, one of which, sketched by Colonel Godwin Austen (whose remarkable surveys in these regions have formed the basis of our topographical knowledge), attained the length of 35 miles. From these glaciers issue streams, which, flowing south between bare craggy mountains, join the Indus or its tributary the Shayok. To the east of Lake Manasarowar a saddle, surmounted by the Mariam-la Pass, connects the northern and central ranges. On its eastern side rises the Sanpu or Brahmaputra, of which the northern range forms the northern watershed as far as to the south of the Sky Lake (*Tengri-Nur* in Mongolian and *Nam-Cho* in Tibetan).

Between the northern and central ranges there runs an important though subsidiary chain from Mount Kailas near Lake Manasarowar to the junction of the Indus and the Shayok. According to Cunningham, who calls it the Kailas or Gangri range, this chain is 550 miles in length. Its peaks average between 16,000 and 20,000 feet in height; and it is crossed in its northern portion by a number of passes which lead from the valley of the Indus into that of the Shayok. The central chain, in its eastern portion, coincides pretty closely with the zone of "central gneiss," the geological main axis of the Himalayas. This great range has its commencement in the conspicuous peak Nanga Parbat ("Naked Mountain"), 26,629 feet high, which towers conspicuously on the extreme verge of the Cashmirian frontier, above the Indus valley, not far from the place where the river enters upon its course through a belt of independent territory, before rejoining the British frontier above Darband. This lofty mountain has been seen from Ramnagar in the Punjab, a distance of 205 miles.

On its northern side the range is clothed with enormous glaciers, which drain into the Sanpu River; while its southern slopes give rise to many large rivers, which, bursting through the southern chain, eventually discharge their waters into the Ganges or Brahmaputra. Foremost among these is the Ganges itself.

The peaks of the southern range constitute a series of the loftiest mountain summits in the known world. Their respective heights have been measured with the utmost exactitude by triangulation from the plains. Many of these exceed 25,000 feet above sea-level, and the highest, named Mount Everest after Sir George Everest, who was surveyor-general of India from 1830 to 1843, is 29,002 feet. It was the highest known mountain until 1883, when Mr. Graham made some remarkable ascents in the Himalayan region, reaching at one point an altitude of 23,700 feet, or at least 1700 feet higher than had ever before been accomplished, and he states that he there observed two peaks, one rock and one snow, which were distinctly loftier. The southern range naturally falls into three divisions or regions, corresponding, as regards organic development, to the three great zones of the earth, tropical, temperate, and arctic. The aggregate breadth of these averages about 90 miles, and they gradually increase in height from the south, a factor which chiefly determines the climate, as for every thousand feet of height gained there is a diminution of 3 or 3½ degrees of Fahr. In the Punjab, the transition from the plains to the outer hills is marked by a belt of dry, porous ground, seamed by numerous gullies or ravines, from 100 yards to a mile wide, partly covered with long, tufty, jungle grass, which is frequented by the black buck or antelope. To the east the Tarai occupies the same position. This is a belt of waste, marshy ground, a fever-stricken region of varying breadth, lying below the level of the plains. This tract affords pasture to innumerable herds of cows and buffaloes. Beyond lies a dry belt of rising-ground, called Bhaver, chiefly of a gravelly and sandy nature, and overgrown with a splendid growth of the valuable timber tree called *sal* (*Shorea robusta*). Next intervenes the fossiliferous sandstone range, which does not rise more than from 300 to 600 feet above its immediate base, but which almost uniformly edges the Himalayas from the Jhelum to Upper Assam. The space between these and the slope of the Himalayas themselves is occupied by the *duns*, the *maris* (in Nepal), and *dwars* (in Bhutan), longitudinal valleys of rising-ground, either cultivated or yielding a plentiful forest growth.

The vegetation clothing this region consists of sals, sissus, acacias, mimosas, cotton-trees, &c.; the fauna, which to the east is plentiful, includes the elephant, rhinoceros, wild bull, buffalo, deer, eagles, with many birds, and a variety of reptiles from the lizard to the python. In the western part of the middle region forests of Himalayan oak, of pine, spruce, silver fir, and of deodar occupy a great part of the mountain slopes, while other denizens of the temperate zones, in addition to tree rhododendra, tea allies, paper and wax trees, occur. The more sunny parts, where forest trees do not flourish (except where rocks jut out), are well covered with herbage, plants, and flowers, resembling those of Central or Southern Europe. The more noticeable among the animal types are bovine and caprine antelopes, sun-bears (Helarctos), leopards, and wild cats. The eastern part of the upper region is one of the superior conifers, though to the north-west these descend to a lower level, while the valleys of the highest regions are there occupied by a few fruit-trees, willows, and poplars. The cedars and deodars of the Himalayas attain magnificent proportions; in the Sutlej valley the former are sometimes 40 feet in girth and 200 feet in height. The chief representatives of the upper region among animals are the so-called bison (*Bos gaurus*), yak, musk-deer, wild goat and sheep, bear, ounce, fox, pheasant, partridge, &c. Generally speaking, the zoology of the Himalayas is much wider in the multitude of its diverse forms (genera and species) than in individuals of the same form, and it is remarkably allied to the zoology of the Malayan Islands; but as one proceeds northwards towards the snows, it approximates to the European types.

So far as is known, the Himalayas exhibit more regularity of structure than the Alps. Three zones of permanent significance can be indicated. On the south there is a continuous fringing belt of lower ridges composed of tertiary rocks. Between this marginal zone and the great snowy range there lies throughout the whole length of the Himalayas, to as far west as the Sutlej, a broad area some

50 miles wide, consisting of irregular ridges of moderate average elevation, from 5000 to 8000 feet, some ranging up to 12,000, all largely made up of crystalline metamorphic rocks, in very obscure relation with some unaltered formations, the latter being for the most part of very uncertain age. This great area, characterized by extreme complexity of structure, is distinguished as the Lower Himalayan region; while the term Central or Tibetan division is applied to the great snowy range, which is characterized by several parallel axes of gneissic rocks and intervening synclinal basins of little altered fossiliferous formations.

Most parts of the Himalayan chains are known to contain metallic ores, particularly iron, lead, and copper, and of the two former there is no deficiency in the mountains between the Sutlej and Kali. Salt, borax, and gold are not unfrequent across the frontier. The region of the Himalayan mountains forms the meeting-ground of the Aryan and Turanian races, the latter having in all probability invaded India at the innumerable points of access to be found along the Himalayan line. The two great stocks are in some places curiously intermingled, though generally distinguishable. To the extreme north-west are found the Dards, an Aryan race of mountaineers, abutting on the Pathans or Afghans on the west; and the Baltis, a race of Mohammedanized Tibetans of the Turanian stock, on the east. To this latter stock also belong the Champas, a race of hardy nomads wandering about the high level valleys of Rupshu, and the Ladakhis, a settled race cultivating the valleys of their country. The other Aryan races are the Paharis or mountaineers, the Cashmiris, and the Dogras and Chibhalis, who inhabit the outer hills.

HIM'ERA, a city in Sicily, was founded by the Zanclæans of Mylæ in Sicily (Strab., vi. 272), and after existing for 240 years was destroyed by the Carthaginians and its ornaments carried off. The inhabitants who survived established themselves at Thermæ, near the site of the ancient town (Cic., "In Verr.," ii. 35), and enriched their new abode with such works of art as they had saved from the wreck. Upon the capture of Carthage, Scipio restored to the people of Thermæ, of Gela, and other Sicilian towns, those monuments of art of which they had been plundered in their wars with Carthage.

HIM'ILCO (or *Himilkon*), a favourite Carthaginian name. Many Carthaginian commanders in the Punic Wars bear it, but the most famous military Himilco is the friend of Hannibal son of Gisco, who conducted to a successful issue the obstinate siege of Agrigentum, B.C. 406, after his colleague Hannibal Gisco had died. He actually attempted to add Syracuse itself to the Carthaginian dominions, defeating Dionysius in a brilliant engagement and driving him into the city; but hardly had he settled down to the siege than a violent pestilence laid half his army sick, and Dionysius, in a vigorous sally pushed on while Himilco was powerless, utt[illegible]y crushed him, B.C. 395. He saved his life by a capitulation, which, however, he felt as such a disgrace that he committed suicide by starvation on his return to Carthage. Another Himilco bravely defended Lilybæum when the Romans attacked Carthaginian Sicily, in the first Punic War, B.C. 250. A third Himilco was of great assistance to the great Hannibal some two centuries later. Again a Himilco, leading a Carthaginian army, appeared before the walls of Syracuse B.C. 212; but this time it was to raise a siege, not to prosecute one. The city was in Carthaginian hands, and the Romans had completely invested it. Again the pestilential marshes round Syracuse did their work, and Himilco perished with a large part of his forces. This was in the second Punic War. Another Himilco (Himilco Phameas) figures shamefully in the third and last Punic War; for being the general of the Carthaginian cavalry, he deserted to the Romans with 2200 cavalry, bribed by the second Scipio Africanus during his siege of Carthage, B.C. 149. Thus had each war its Himilco.

A man of the same name made himself nearly as interesting to us as his compatriot HANNO. He too sailed on a voyage of maritime discovery in the fifth century before Christ. Hanno after passing the Pillars of Herakles (Straits of Gibraltar) turned southwards; Himilco did so likewise, and sailed directly onwards till he was stopped by a windless region, the sea in which was choked with seaweed. Had he changed his direction, and was this the great bank of seaweed which lies off the Bahamas? The Carthaginians in their jealous commercial spirit kept any trading information they acquired as secret as possible, and beyond what is mentioned above not much is known of the famous four months' voyage which so nearly discovered the New World.

HIND is properly the female of the stag or red-deer, but the term is also applied to the females of other species of deer.

HIN'DI, one of the principal modern languages of India, is the tongue of the Hindus proper, and bears, with Bengali and Marhatti, roughly speaking, somewhat the relation to the ancient Sanskrit which Italian, Spanish and French do to Latin. One of its chief varieties is the Hindustani. Hindi is spoken in Northern India. From it several words have passed by importation from our great dependency into the common English speech. Such are calico, chintz, dimity, jungle, muslin, nabob, pagoda, palanquin, pundit, rajah, rice, rum, sugar, and toddy.

Hind, in ancient Persian, and its correlative *Sind*, in Sanskrit, mean dark or black. Hindu corresponds precisely to our "darkey." *Ian* means country; *Hindustan* means therefore "Land of the dark race."

HINDUSTAN, HINDU ARCHITECTURE, LANGUAGE, &c. See INDIA, INDIAN ARCHITECTURE, &c.

HINDUSTAN'I or **URDU,** one of the chief languages of India, is a modification of HINDI, having a great infusion of Arabic and Persian words, introduced by Mohammedan influence. It is confined to Northern India.

HINGE, a kind of joint upon which doors, gates, shutters, box-covers, &c., are made to turn in the act of opening and shutting. Hinges are constructed in a great variety of forms, but in most of the commoner kinds the action is that of a hollow cylinder working round a fixed central pin. In Collinge's patent hinges, which are peculiarly adapted for hanging large heavy doors and gates, the principal rubbing action is between a hollow cap and an accurately turned sphere, formed, as it were, upon the end of the pin, a cavity being provided for the reception of a supply of oil to lubricate the rubbing surfaces. Redmund's rising hinges are frequently used for hanging room-doors in houses of superior character. In ordinary door-hinges the hollow cylinder which works round the axis or central pin is divided transversely into two or more portions; but in the rising hinges, instead of the hollow cylinder being divided transversely at right angles, it is divided by spiral or rather helical lines. The result of this contrivance is that when the door is opened it is lifted up a little from the floor by the sliding upon one another of the inclined helical surfaces; so that, although the door may shut very close to the floor, it rises when opened to a sufficient height above the floor to allow its lower edge to clear the carpet. Other forms of hinges are very numerous, and of late years, in connection with buildings in the Gothic style of architecture, there has been a revival of the elaborately ornamented mediæval hinges.

HINNY is a word derived from the Latin *hinnire*, to neigh, and is used to designate the produce of the horse and the she-ass, as the word *mule* does the hybrid of the he-ass and the mare. The hinny is rare, and though more docile, is less valuable than the mule.

HIP and **HIP-JOINT.** See LEG.

HIPPAR'AFFIN, a crystalline inflammable substance obtained from hippuric acid by oxidation, hipparin being formed at the same time. Hipparaffin is insoluble in cold water, partially soluble in boiling water, and very soluble in alcohol and ether. It crystallizes in silky needles, and dissolves in sulphuric acid without decomposition. It melts at 200° C. (392° Fahr.), and at a higher temperature sublimes unchanged. The formula is $C_8H_7NO_2$. Hipparin also crystallizes in silky needles, is soluble in alcohol and ether, and melts at 45·7° C. (114° Fahr.) Its formula is $C_8H_8O_2$.

HIPPAR'CHUS (*Hipparchos*), the first astronomer who really made systematic observations, and left behind him a digested body of astronomical science. He was born, according to Strabo, at Nicæa in Bithynia, and was alive, as appears from his observations preserved by Ptolemy, in the interval between 160 and 125 B.C.; but neither the year of his birth nor of his death is recorded. His astronomical observations were probably commenced in Bithynia, and certainly continued at Rhodes; whence he is called by some authors the Bithynian, and by others the Rhodian, and some even suppose two astronomers of the same name, which is certainly incorrect. The writings attributed to Hipparchus are all lost except a commentary on Aratus, written probably when he was young, since he does not mention any of his subsequent discoveries, and the results of observation are not so correct as those of his catalogue.

The remarkable powers of Hipparchus will appear if it is remembered that his astrolabe was nothing but an armillary sphere, of no great diameter, and with very small subdivisions of a degree, as well as that he had neither telescope, vernier, nor micrometer. At this day we dispute about a fraction of a second; they could not then answer for any fraction of a degree, and might be wrong by a whole diameter of the sun or moon. Hipparchus is the true founder of astronomy. He was the first who gave and demonstrated methods of solving all triangles, whether plane or spherical. He constructed a table of chords, of which he made nearly the same use as we now do of our tables of sines. He made many more and much better observations than his predecessors. He established the theory of the sun in such a manner that Ptolemy, 263 years afterwards, found nothing to change. It is true that he mistook the inequality of the sun's motion, but it can be shown that his mistake arose from an error of half a day in the time of the solstice. He himself avows that he may have been wrong by a quarter of a day; and we may always safely suppose that, without impeachment of an author's integrity, his self-love may half the error which he is really liable to commit. He determined the first inequality of the moon (the equation of the centre), and Ptolemy found nothing to change in his result; he gave the mean motion of the moon, and that of the apogee and nodes, in which the corrections made by Ptolemy were slight, and of more than doubtful value. He had a suspicion of the second inequality (the evection); it was he who made all the observations necessary for a discovery of which the honour was reserved for Ptolemy. He showed that all the hypotheses of his predecessors were insufficient to explain the twofold inequality of the planets; he predicted that none would be successful which did not combine the two hypotheses of the excentric and epicycle. He had not the proper observations, because they require more time than the duration of the longest life; but he made them ready for his successors. We owe to his catalogue the important knowledge of the retrograde motion of the equinoctial points. We might, it is true, have derived this knowledge from much better observations made within the last 100 years; but we should then have had no proof that this motion remains sensibly the same through a long course of ages; and the observations of Hipparchus, by their number and their antiquity, and in spite of the errors which we are obliged to admit, give important confirmation to one of the fundamental points of astronomy. It is to him that we owe the first discovery of this phenomenon. He also invented the planisphere, or the method of describing the starry heavens upon a plane, and of deducing the solution of problems in spherical astronomy by a method often more exact and convenient than that of the globe itself. He is also the father of real geography, through the happy idea of marking the position of towns in the same manner as that of the stars, by circles drawn through the pole perpendicularly to the equator, that is, by latitudes and longitudes. His method, by means of eclipses, was for a long time the only one by which the longitude could be determined; and it is by means of the projection of which he was the author that we now make our maps of the world and our best geographical maps.

HIPPA'RION. See EQUIDÆ.

HIPPOBOS'CA. See FOREST-FLY.

HIPPOCAM'PUS, MAJOR and **MINOR,** is the name given to two projections from the wall of the ventricle of the brain. The *hippocampus major* occurs in the middle lobe of the brain, and in the descending cornu (horn) of the ventricle. The much smaller *hippocampus minor* is famous from its position in the Darwinian controversy. It occurs in the posterior lobe of the brain. A sulcus runs along the floor of the cornu, which arches over it, so that it is as if it had been driven up from without by a blunt tool in the way that metals are embossed. As the projection is somewhat of the shape of the little fish called hippocampus, it receives this name. Now it was long alleged, first, that apes had no posterior lobe, and then, when this could be no longer defended, the last resource was the absence of a hippocampus minor. But further examination has shown that all the higher apes have this structure in their brains, though the lower apes have either no posterior lobe or else a rudimentary one, and hence are without the hippocampus minor. Therefore this structure, of which no one as yet knows the function, so far from separating man from the higher apes, is a most marked link of connection between them. See the whole question exhaustively discussed in "Man's Place in Nature" by Professor Huxley, F.R.S. (London, 1864).

HIPPOCAM'PUS. See SEA-HORSE.

HIPPOCRATES. See HIPPOKRATES.

HIP'PODROME (Gr. *hippos*, a horse; and *dromos*, a racecourse), a large inclosed space set apart by the ancient Greeks for their horse and chariot races. There appears to have been little substantial difference between the Greek hippodrome and the Roman circus, except that, from the Romans not having been accustomed to allow more than four chariots to compete at once, the circus was made much narrower than the hippodrome. Bearing this distinction in mind, and that the number of chariots which ran necessitated a more complicated arrangement of the *carceres*—they being placed along a line formed like the prow of a ship, with the apex towards the area, and each of the sides 400 feet long—a sufficiently clear conception of the form and character of the hippodrome will be obtained by a reference to the article CIRCUS. The term hippodrome, like that of "circus," is often used by the exhibitors of equestrian performances to signify the tent or building in which they appear.

HIPPOK'RATES or **HIPPOC'RATES,** the most celebrated physician of antiquity. He was born about the middle of the fifth century B.C., in the island of Cos, off the south-west corner of Asia Minor, among the groups of Ionian colonies which made a "Greater Hellas" there. He was reputed to have lived more than a century, dying in Thessaly about B.C. 355. He travelled extensively in Greece, but apparently not elsewhere, though he was warmly invited by the Persian king to emigrate and become a

member of his court. No actual details are known of Hippokrates' life, but many evidently half-mythical tales cluster round his name. A large number of treatises remain bearing his name—some fifty or sixty, probably only a few of which are genuine. The whole body, however, constituted the groundwork of the entire ancient medicine; each succeeding great physician writing a commentary upon them. Like so many professors of the healing art, Hippokrates was a man of culture and wide attainments, and perhaps the best known apophthegm of antiquity is due to him, the famous and ever-true "Life is short, art is long;" though, as it is so frequently quoted in its Latin form (*Vita brevis, ars longa*), it rarely gets set down to its true Greek source.

HIPPOKRE'NE or **HIPPOCRE'NE** ("fountain of the horse"), a spring at the foot of Mount Helicon in Bœotia, sacred to the Muses. The mountain was rising under the sway of the song of the Muses, until Poseidon, alarmed, bade the winged horse Pegasus strike it with his foot and stay it. From the hoof-print Hippokrene gushed forth.

HIPPOL'YTA (*Hippolutê*), Queen of the Amazons in the Greek mythology. [See AMAZONS.] She derived her fierce temperament and her great strength from her father, the god Ares, who gave her a magnificent zone or girdle. The fame of this having reached the daughter of Eurystheus, the latter sent the hero Herakles (condemned for a time to do his bidding) to wrest this gift from the Amazonian queen. Herakles succeeded in his task [see HERAKLES], and according to some accounts the queen perished in the fierce combat. The more usual tale is, however, that Theseus, king of Athens, the friend of Herakles, wishing to try his mettle against these fierce women, fell in love with the queen when he had conquered her, and brought her to Athens as his wife. Her son was the ill-fated HIPPOLYTOS. It is the marriage-feast of Theseus and Hippolyta which forms the basis of Shakspeare's "Midsummer Night's Dream."

Another version of the myth is that Theseus carried off Antiope, the sister of Hippolyta, and that the latter, at the head of the entire tribe of Amazons, invaded Attica, and was with difficulty repulsed. When at length the Athenians vanquished her in battle, she fled to Megara and put an end to her life from shame.

HIPPOL'YTOS was the hero of one of the saddest stories of the Greek mythology, and of one of the grandest tragedies of Euripides. He was the son of Hippolyta, queen of the Amazons, by Theseus, king of Athens, and was an ardent worshipper of the virgin goddess Artemis. After Hippolyta's death, Theseus married Phaidra (or *Phædra*), and she played against her stepson the dishonourable part of Potiphar's wife. Hippolytos, out of regard for the peace of mind of his father, kept silent as to the unnatural conduct of his stepmother, Theseus, on receiving the shameful accusation from her, invoked the aid of the god Poseidon to put out of existence such a vile son as he believed Hippolytos upon his wife's false tale to be—unhappily without confronting him with his accuser. As the poor youth was driving by the sea-shore in his chariot, therefore, Poseidon sent a monster from the waves, and the frightened horses ran away, overturned the chariot, and dragged their master after them—a frightful death. Theseus eventually learnt the truth, and Phaidra hung herself in her despair.

HIPPOL'YTUS (*Hippolutos*), a bishop and ecclesiastical writer of the third century who has acquired importance in connection with a treatise discovered in modern times, which was edited, with explanations and dissertations, by Chevalier Bunsen. The discovery of this treatise was somewhat remarkable. It was found among various other MSS. brought from Mount Athos to Paris in 1842, and deposited in the royal library there. It was designated as a "Book on all the Heresies," but without any author's name. M. Emmanuel Miller, a functionary of the institution, was attracted to it by some fragments of Pindar that it contained. On examining it he came to the conclusion that it was a lost production of Origen; and under this impression the Oxford University press agreed to publish it. It appeared in 1851. It was soon after its publication carefully studied by Bunsen; and the conclusion at which he arrived regarding it was that it was a genuine production of the third century, but that its author was not Origen but Hippolytus. Various scholars—Dr. Duncker and Dr. Jacobi in Germany, and Dr. Wordsworth in England—confirmed this opinion, which is now generally accepted. The character and position of Hippolytus have become much better known than before in connection with the inquiry excited by the recovery of this treatise. He was a Roman ecclesiastic and bishop of Portus, the harbour of Rome on the northern bank of the Tiber, lying opposite to the ancient Ostia. In the third century this appears to have been a place of some commercial importance and of considerable population. The great metropolis of the world brought ships from all maritime countries into its harbour, and especially many Greek sailors and merchants. Among this trading Greek population Hippolytus lived and laboured. A Roman ecclesiastic, he was yet Greek in speech, and Greek in his mode of thought. He was a disciple of Irenæus, bishop of Lyons, who again was a disciple of Polycarp of Smyrna, who had seen and conversed with the apostle John. While occupying an independent position in his own bishopric, he was directly connected with the Roman Church as a member of its presbyterial council. In the ninth book of the recovered treatise on heresies, Hippolytus gives us a somewhat lively account of the religious and ecclesiastical state of Rome in the middle of the third century. According to this account it by no means presented the picture of unity which many would fain attribute to the early Roman Church. Two of the Roman bishops, Zephyrinus and Callistus, are accused of favouring the heresy of Nœtus—a kind of early unitarianism; and it is evident, moreover, that various scandals were abroad as to the latter of these bishops. Hippolytus appears as an earnest and energetic churchman and defender of the faith. The pupil of Irenæus, he was the friend and precursor of Origen in the speculative and critical study of Christian doctrine, and in oratorical talent. In his "Refutation" of the heresies of his day he shows an enlightened acquaintance with the course of Grecian speculation, as well as with the meaning and application of Scripture. He was, according to Bunsen, one of the first preachers in the Roman Church. Before his time preaching had been merely a popular exposition of the gospel of the day. He enlarged this exposition into the formal homiletic address, in which he treated of Christian topics in an elaborate and scientific manner.

HIPPOPH'AË, a genus of plants belonging to the order ELÆAGNACEÆ. The only species of this genus is the *Hippophaë rhamnoides* (sea buckthorn or sallow thorn), which is a small shrub found on the east and south-east coasts of Great Britain and other parts of Europe. The acid berries yielded by this plant are often eaten as a salad both in this country and in France. This plant also yields a colouring matter which is used for dyeing yellow. Although in this country the berries are innocuous, they seem to exert a deleterious influence, or are supposed to do so, in some of the countries of the south of Europe. The male and female flowers occur on separate plants, the male in catkins, the female in the axils of the leaves. The berries are formed by the tubular calyx becoming fleshy and inclosing a single seed; they are produced in great abundance, and as they are of a reddish-orange, the plant has a very showy appearance. Though generally considered a sea-shore plant, it grows to great perfection in the inland parts of England and the Continent.

The leaves are narrow, of a dull green colour on the upper surface, and below they are covered over with silvery scaly hairs.

HIPPOPOT'AMUS is a genus of the artiodactyle Ungulata, forming the family Hippopotamidæ. Only two species, both confined to Africa, are now living. Formerly the Hippopotami enjoyed a much wider distribution, as may be gathered from the numerous fossil remains occurring in the Tertiary beds of Great Britain, Europe, and India. At least nine fossil species have been described, one of which is identical with the common recent species, *Hippopotamus amphibius*.

The Common Hippopotamus (*Hippopotamus amphibius*), river-horse, or sea-cow, as it is variously called, is found in many of the rivers of Africa from the Sahara to Cape Colony. It is also at times found on the sea-coast. This huge unwieldy animal is little inferior in bulk to the elephant, though lower in stature, owing to the shortness of its thick pillar-like legs. The head is ponderous, terminated by a large swollen muzzle which covers the array of the huge teeth when the mouth is closed, and the great thick lips are studded with wire-like bristles. The mouth is wide, the nostrils open on the top of the muzzle, and the small eyes are situated high on the head; hence by raising only a small section of the head above the surface of the water, the animal can breathe and look around, the body remaining submerged. The mouth is furnished with forty teeth, there being eight incisors, four canines, sixteen premolars, and twelve molars. The inferior incisors project horizontally forwards, the central pair being the longer. The worn crowns of the large

Common Hippopotamus.

canines are perfectly smooth and opposed vertically. These tusks are enormous, those in the lower jaw curving upwards like the tusks of a boar. The molars are crowned with two pairs of bold elevations which wear down by attrition, when the form of a trefoil is exhibited on their crowns. The premolars are conical. There are four toes on each foot, nearly equal and armed with small hoofs. Aquatic plants, and especially grasses, constitute the bulk of the food of these animals. The hide is of immense thickness, being upwards of 2 inches deep on the back and sides; it is extremely dense, and is manufactured by the natives of various districts, both of northern and southern Africa, into shields, whips or scourges, and other articles. Between the skin and the flesh a layer of fat intervenes, which is salted and eaten as a delicacy by the Dutch colonists of South Africa, by whom it is termed sea-cow's speck (bacon). The flesh also is said to be excellent. The tusks are especially valuable for making artificial teeth.

The general colour of the hippopotamus is dusky brownish-red, passing on the sides and limbs into a light purple red or brown; the under parts, the lips, and the eyelids are light wood brown, with a tinge of flesh colour; the hinder quarters are freckled with spots of dusky brown. The hairs which fringe the tail and ears are black, the bristles on the muzzle yellowish-brown. A full grown hippopotamus attains a length of 12 feet, while the girth of its body scarcely measures less; it stands about 5 feet high at the shoulders. The male considerably exceeds the female in size. A single young one is produced at a birth.

The hippopotamus is gregarious, and to a great extent nocturnal in its habits; during the day it remains under its fluid canopy, rising every five or six minutes for the purpose of respiration. At night it comes on land to feed, at least in districts fully inhabited by man, and often travels to a considerable distance in quest of some favourite diet. It visits the plantations of grain, trampling down as much as it consumes, and doing great damage. It is an expert diver and swimmer, while its speed on land is astonishing considering its unwieldy frame and the shortness of its legs. The hippopotamus is wary and indisposed to act on the offensive, yet, in districts where the sound of a rifle is seldom heard, it shows but little fear of man. When attacked and wounded, the hippopotamus becomes exceedingly furious, and, if on land, rushes open-mouthed on its aggressor. But the danger from the vengeance of this animal to boats and their crew on the water is far greater. Among the various modes of destroying this persecuted animal that of shooting them is of course the most effective; nevertheless, the sport is attended with much difficulty, as when in the water they are only vulnerable immediately behind the ear. The ordinary weapon employed by the native hunters is a harpoon attached to a line. On land the harpoon is also employed as the principal part of a trap called the "downfall." The instrument, loaded with heavy weights, is suspended from the bough of a tree, and is in connection with a string below, which being touched by the beast causes the weapon to descend on its head. The hippopotamus is also taken in pitfalls.

We need not attempt a laboured exposition to prove that the hippopotamus was known to the ancients, although it may be admitted that some of the descriptions of the older writers, as Herodotus, Aristotle, Diodorus, and others, are more or less incorrect. Scaurus, during his ædileship, exhibited one of these animals at Rome. Augustus exhibited one on his triumph over Cleopatra, and at subsequent periods under the later emperors they were introduced into the Roman amphitheatre. Commodus showed five on one occasion. The hippopotamus is very tolerably delineated on the Prænestine Pavement.

The first hippopotamus seen in Europe in modern times was brought to the London Zoological Gardens in 1850, where he lived till his death in 1878. In 1853 a female was obtained, but produced no offspring till 1871; the two calves born in that year (the second after an interval of nine months) both died; but a female calf was born towards the end of 1872, and the society has since acquired a young male.

The Liberian Hippopotamus (*Hippopotamus liberiensis*), a native of the west coast of Africa, is exceedingly rare. One of its distinguishing peculiarities consists in the presence of only two incisor teeth in the lower jaw. It is much smaller than the common species.

HIPPU'RIC ACID, an acid found in the urine of horses, oxen, and other herbivorous animals; it is also found to a less extent in human urine. It is obtained by evaporating the urine of the horse to a small bulk and acidifying with hydrochloric acid, which throws it down as a brown powder. It can also be made artificially from benzoic acid by heating it with glycocine. Benzoic acid and quinic acid are both converted into hippuric acid in the animal economy. It is obtained in large colourless prisms, soluble in cold water, very soluble in boiling water and in alcohol, but not in ether. It boils at 240° C. (464° Fahr.), decomposing into benzoic acid and benzonitrile,

The formula is $C_9H_9NO_3$. It is monobasic, and forms a great number of salts of definite character, called hippurates. These are mostly crystalline and soluble in water; those of iron, silver, and mercury are white insoluble precipitates. All the hippurates, when fused with potash, give off ammonia and benzene. There are a number of conjugated hippuric acids, of which chlorohippuric, nitrohippuric, and sulphohippuric acids are the best known. These all form a great variety of salts.

Hippuric ether or *hippurate of ethyl* ($C_{11}H_{13}NO_3$) is a crystalline body, soluble in alcohol, and melting at 44° C. (111° Fahr.) *Hippurate of methyl* ($C_{10}H_{11}NO_3$) is a somewhat similar body.

HIPPU'RIS, a genus of plants belonging to the order HALORAGEÆ. Three species of this genus have been described. Of these *Hippuris vulgaris* (the common mare's tail) is found abundantly throughout Europe and North America. It is found in ditches and lakes, and is very common in Great Britain in stagnant waters and slow streams.

HIPPURIT'IDÆ is a remarkable family of fossil molluscs exclusively confined to the cretaceous strata. So abundant are species of this family in rocks of the cretaceous era in the south of France, Spain, Sicily, Greece, and other countries bordering the Mediterranean, that the name Hippurite limestone has been applied to these strata. The Hippuritidæ are "the most problematic of all fossils; there are no recent shells which can be supposed to belong to the same family, and the condition in which they usually occur has involved them in greater obscurity." They have been variously assigned to the corals, the annelid worms, the cirripeds, and the brachiopods and cephalopods among molluscs. Their true nature was determined by Dr. S. P. Woodward. The characters which determine their position among the lamellibranchiate molluscs he gives as follows:—

1. The shell is composed of three distinct layers.
2. They are essentially unsymmetrical and right-and-left valved.
3. The sculpturing of the valves is dissimilar.
4. There is evidence of a large internal ligament.
5. The hinge-teeth are developed from the free valve.
6. The muscular impressions are two only.
7. There is a distinct pallial line.

In the Hippuritidæ the valves of the shell are very unequal; the lower valve, by which the animal was fixed to the rocks, is very large and conical; it was closed by a small free valve. The principal genera are—Hippurites, with thirty species; Radiolites, with forty-two species; and Caprina, with ten species.

HIR'CIC ACID, an oily acid of uncertain composition, obtained by Chevreul from mutton suet, and to which the peculiar odour of that article is attributed. It is slightly soluble in water, and forms soluble salts with potash and baryta.

HIRING is the contract by which property or labour is employed for a limited time for some consideration or reward. In Roman law four kinds of hiring were distinguished—(1) of a thing for use; (2) of work and labour; (3) of services for taking care of a thing; (4) of carriage of goods. The term can hardly be described as strictly technical, except perhaps in the cases where the services of a man or the use of a thing for a limited period are engaged, and the various kinds of hiring are separately considered in this work in the articles BAILMENT, CARRIER, LODGINGS, LANDLORD AND TENANT, &c.

HIRNANT' LIMESTONE occurs in the BALA BEDS. It crops out between Bala and Dinas-Mowddwy and in the Hirnant valley some distance above the Bala limestone. It is a black pisolitic limestone, containing the fossils *Orthis Hirnantensis*, *Orthis sagittifera*, &c., Arca, and Modiolopsis.

HIRUDI'NEA is an order of ANNELIDA comprising the worms, to which the name LEECH is given.

HISPANIO'LA. See HAYTI.

HIS'SARLIK, a hill in the plain of Troy, in the north-east of Asia Minor, close to the southern mouth of the Hellespont, which Dr. Schliemann declares to be the acropolis of the ancient Troy. In his account of the remarkable excavations conducted by him ("Ilios," 1880) Dr. Schliemann distinguishes five prehistoric cities and two historic:—(1) Remains of the Greek Ilium, reaching down to about 6 feet below the surface; (2) below this a Lydian city. Then (3) fifth prehistoric city; (4) fourth prehistoric city; (5) third prehistoric city; (6) second prehistoric city; (7) first prehistoric city, founded on the native rock, about 52½ feet below the surface, and about 59½ feet above the present level of the plain.

In 1882 the excavations at Hissarlik were studied by two eminent architects, whose services Dr. Schliemann specially engaged for that purpose—Dr. Wilhelm Dörpfeld, who for five years was at the head of the technical works of the German excavations at Olympia, and Dr. Joseph Höfler.

Dr. Dörpfeld distinguishes—(*a*) The Greek Ilium of the *latest* or *Roman* age, down to the same depth at which, according to "Ilios," even the earliest traces of the Greek Ilium cease. (*b*) Remains of a town which, like *a*, was not confined to the mound of Hissarlik, but extended over the adjacent plateau—probably the Greek Ilium of Macedonian age, taken by Fimbria in 85 B.C. (*c*) Remains of a town probably confined to the mound. Greek Ilium of earlier age, taken by Charidemus about 359 B.C. *d*. Remains of a smaller town, or rather of a village, confined to the mound. *e*. Remains of a large town, which extended over the plateau, and had only a few large buildings on the mound, its acropolis. Possibly Troy. *f*. A few remains of buildings which may represent a town distinct from e; the reasons for thinking it distinct being that some buildings of e are above it, and that the ground on which e stands appears to have been carefully levelled.

HISTOL'OGY (Gr. *histos*, a tissue; *logos*, a discourse), the name given to the doctrine of the tissues which make up the different organs of the animal frame. In fact it is the microscopical study of anatomy. Professor Schwann classifies the fundamental tissues of the human body as follows:—(1) Simple membrane—examples, walls of cells, capsule of lens of the eye, &c.; (2) fibrous tissue—examples, white and yellow fibrous tissue, elastic tissue, &c.; (3) cellular tissue—examples, cartilage, fat, gray nerve-matter, &c.; (4) sclerous or hard tissue—examples, bone, teeth, &c.; (5) compound membranes—examples, mucous membrane, skin, synovial membranes, &c.; (6) compound tissue—examples, nerves, muscles, and fibro-cartilage. These, and the many subdivisions of each branch, fall to be considered by the histologist.

HISTORY. The present age has seen, and is seeing, the most remarkable outburst of historical labour that the world has ever witnessed. The Oriental works of Rawlinson, &c., the Greek histories of Grote and of Curtius, the Roman histories of Mommsen and Ihne, with their predecessors by Arnold and Merivale, the church histories of Milman and Ranke, the French histories of Michelet and Martin, and finally the works on our own historical past, such as Carlyle's "Oliver Cromwell," Freeman's "Norman Conquest," Macaulay's "History of James II. and William III.," Gardiner's series of works on the earlier Stuarts, Froude's on the Tudors, Green's unrivalled "Short History of the English People," are of themselves amply sufficient to bear out this statement. Macaulay began the new method, Carlyle with his "French Revolution" marked its greatest splendour, and with his "Frederick the Great" attained its most colossal achievement. Further, a new solvent has been discovered in our own day; mysteries of

international affinity hitherto dimly guessed at are now detected and analyzed by our linguists, with the penetrative aid of comparative philology, to the great benefit of the conscientious historian. The comparative mythologists also represent another new force in historical analysis. The passion for real historical research goes yet deeper. Nothing is to be taken for granted; contemporary evidence is to be procured at any cost; hearsay is discountenanced on all hands. The admirable collection of our ancient chronicles and national records published under the Master of the Rolls, the work of the Early English Text Society, of the Camden Society, &c., are remarkable instances of this laudable activity among genuine sources. Reprints of ancient chronicles find a ready market now, even with the general public. Half a century ago they would have been read but by a handful of scholars.

But the spirit infused into this splendid mass of work is what renders it so distinctive as to warrant us in claiming it as a new departure. It breathes in the few words with which Green introduces his "Short History of the English People," a book which, though of moderate size and thoroughly popular in style, at one step placed its author in the forefront of our national historians. Green says, repeating and amplifying the words of Macaulay used at the beginning of his own history, "It is a history, not of English kings or English conquests, but of the English *people*. . . . Whatever its worth may be, I have striven throughout that it should never sink into a drum-and-trumpet history. It is the reproach of historians that they have too often turned history into a mere record of the butchery of men by their fellow-men. But war plays a small part in the real story of European nations, and in that of England its part is smaller than in any other. . . . If some of the conventional figures of military and political history occupy in my pages less than the space usually given them, it is because I have had to find a place for figures little heeded in common history—the figures of the missionary, the poet, the printer, the merchant, or the philosopher."

Our greatest historian of the century, Thomas Carlyle, is never weary of enforcing this text, both by homily and by the most wonderful work ever done in that line. "What good is it to me," he asks in one of his essays ("Boswell's Life of Johnson"), "to have dinned into my ears that a man named George III. was born and bred up, and a man named George II. died; that Walpole, and the Pelhams, and Chatham, and Rockingham, and Shelburne, and North, with their coalition or their separation ministries, all ousted one another, and vehemently scrambled for the thing they called the rudder of government? . . . The thing I want to see is not court calendars and Parliamentary registers, but the *life of man* in England; what man did, thought, suffered, enjoyed; the form, and especially the spirit, of their terrestrial existence—its outward environment, its inward principle, how and what it was, whence it proceeded, whither it was tending."

Not that Carlyle, of all men the most voracious of facts, even the most trifling, if they tell upon his immediate object, is to be held as herein recommending the nerveless stuff our fathers called "philosophical history." His own works bristle with facts. But they are all subordinated to his purpose; and his purpose, like that of all the great historians we have named, is to use history as a great moral force, to extract from it the practical teachings it holds for us, to profit by the painful experiences of our ancestors that we may avoid them for ourselves, to learn to see with their eyes that we may hereafter use our own to the better advantage, and the like. History, as a collection of tales, is well called by him in derision *dryasdust;* the "Arabian Nights" or the "Hitopadesa" excel it by far. But history as a divine book of revelations, whereof a chapter is completed from epoch to epoch, with great men for its inspired texts, is of all studies the most elevated and the most interesting. Pope has wisely said—

"The proper study of mankind is man."

The old patriotic style of history has died out. Historians now treat their subject in such a way as to show of what interest a certain group of events happening to a certain group of men were to the whole brotherhood of man. In one word, history has taken its true stand-point as *philosophy teaching by experience.*

To a free nation with an elastic constitution, such as our own, history is of all studies perhaps the most immediately profitable; because we are in that happy condition of being able to benefit by its teachings, whatever they are. This consideration also adds to the need of absolute veracity in historians. When we find, for instance, Hume telling as genuine history the tale of Æthelwald—sent to court Ælfthryth (Elfrida) for the English King Edgar, and basely marrying her himself (telling the king she was unworthy), whereupon the king on discovering the fraud kills the faithless ealdorman at a hunting party—and when we find on referring to Hume's authority, William of Malmesbury, that the old chronicler simply gives the tale because it is interesting in itself, expressly saying that it has no authenticity beyond traditional ballads, centuries old even in his day, we nevermore feel quite safe with Hume as our guide. William, writing in Stephen's troubled times, has more of the true historian's fidelity, with all his garrulousness, than the all-accomplished scholar of the eighteenth century. But when, on the other hand, we find such splendid and complete veracity, as in the great historian of our own day, who, setting out to show his view of the true method of government (that is, to put "your ablest man," your national hero, at the helm of the state, and wholly intrust the vessel to his care), succeeds with the vast majority of Englishmen in elevating Cromwell to his true position of national hero, but succeeds also in demolishing his own argument by his own all-powerful facts—when we find him, to most minds, irresistibly demonstrating the futility of a tyranny, even the tyranny of a hero and a true statesman and patriot such as Oliver Cromwell, then we feel the true grandeur and many-sidedness of history, and fear not to trust implicitly to a guide who thus fairly places before us materials wherewith to form our opinion. Whether it shall coincide with his opinion or not is our affair, not his: but it is our first demand of him that he shall not bias the facts knowingly, neither by misstatement nor concealment.

Not even a Carlyle can make the tyranny of one man, even of a Cromwell, palatable to Englishmen. On the other hand, in depicting the terrors of the tyranny of the mob in his "French Revolution," Carlyle carries every Englishman with him. From Grote and Mommsen, again, we learn what crushing tyranny can arise under the various forms of uncontrolled oligarchy, whether by citizens or by cities, such as were known to the ancient worlds of Greece and Rome; and from Milman we gather the stifling nature of the tyranny of a powerful and irresponsible priestly despotism, or we learn the opposite evils of a church serving the base and temporary needs of some imperious master who has her for the moment in his power. If we combine the reading of Mommsen ("Rome") with that of Carlyle ("French Revolution") we can see readily enough that it is impossible permanently to keep masses of men from influencing the government, and that if they are to do so they had better do it openly and legally. When they are refused this, we get the typical government of Russia—"a despotism tempered by assassination," or we get the terrible general conflagration and overthrow and wild ruin Carlyle has told of France. But the admission of the whole people to some sort of elective franchise, as Mommsen shows with ancient Rome, is an easy thing when done, though it may

look full of terrors before it is attempted. The danger has always lain not in the extension of the franchise, but in the excited tempers (resulting in "secessions of the plebs" or in "National Conventions" or in "Nihilist" movements, as the case may be) which are aroused during the struggle for it.

As regards modern historical methods they will be found to resolve themselves into two. The first is to take a principle or a group of principles, and trace their development, as Buckle has done in his stupendous fragment on the "History of Civilization," or Lecky in his "History of European Morals." The second is to keep pace with the general movement of the epoch under consideration by selecting certain points round which events group themselves in masses—minor facts round some central fact—and thus leaping from height to height while preserving an ample view over the whole plain beneath. The selection of such suitable stations whence to look down upon the rapidly shifting scene beneath is the great difficulty of the historian; he has often to disregard strict chronological sequence—to defer here, to accelerate there; but ever to be sure that from the next halting-place the view shall be such as to embrace what was perforce passed over in the last. This selection is not to be governed by rules, it is an affair of genius. Thus it is that Carlyle's prose epic, "The French Revolution," bounds along with irresistible force. We are whirled through that stormy time, but we miss nothing of importance by the way.

Such points of view are afforded very frequently by biographies, and consequently we find our great historians all of them great biographers. So much gathers round one man, and he sometimes by no means the official figure-head of his time, that in many places this is the best method of historical teaching. Macaulay adopted it with the most unqualified success. His essays—Burleigh, Walpole, Chatham, Clive, Hastings, Temple, &c.—are perhaps even more read than his history. In fact, history is but the essence of innumerable biographies, or to use a phrase of Carlyle's, it is the "universal *autobiography* of mankind;" the message from the past to every man. Yet how often have we been annoyed by tales of Alfred and the cakes, of Dunstan and the devil, and the like, filling the pages of our books with mere unsupported legend, while what we want to know is how the one built up the state and the other the church. And how often do we get downright perversions of historical accuracy, whether sheer falsehoods, as the massacre of the Welsh bards by Edward I., or specimens of the logical fallacy of *ignoratio elenchi*, such as the glorification of William Wallace or the early part of the Bruce's career to the implied detriment of the noble and chivalrous Edward. Or we have the victories of Crecy and Poitiers enlarged upon until it seems as if the reign of Edward III. were a reign of military advantage, instead of being, as it was, a reign of constant loss, wherein whole countries and provinces slipped away from England with the one solitary town of Calais to show as a counterpoise.

In correcting such errors many of our later historians take a wide sweep. Tell's apple has had to give way amidst the universal regret, and henceforth disappears from history; and Richard Crookback is found to be vouched for as a finely made man, the fitting brother of the handsome Edward IV., by an eye-witness who told Stow the antiquary of the fact, &c. Allowances of this kind, from the partiality of friends in the one case, or the equally gross animosity of foes in the other, have perpetually to be made. In fact the present tendency is to be rather too ruthless in this particular. The greatest ingenuity is required to sift out what grains of truth may lie in these myths and legends. The myths surrounding the Emperor Karl the Great (Charlemagne) are an excellently knotty example. As regards the earliest legendary history of a country, we have on the one side the school of Grote, which refuses to see any historical value in the tales, and on the other the school of Freeman, which endeavours cautiously to find out the historic basis, often very slight, on which they are founded.

"Such is the grand sacred Epos, or Bible, of World-History; infinite in meaning as the Divine Mind it emblems; wherein he is wise that can read here a line and there a line" (Carlyle, "Cagliostro").

HISTRIO'NES, pantomimic actors among the ancient Romans, who were considered as inferior to the performers of the regular drama. Hence was derived the term *histrionic*, as applied to the modern stage.

HITCHES and **BENDS** are varieties of what landsmen call by the general term *knot*. They serve to fasten one rope to another rope, or to a piece of timber, a mast, a ring, &c. Their nature and office is more fully described under KNOT.

HITCH'IN, a market-town of England in the county of Hertford, beautifully situated at the foot of a steep hill belonging to the Chiltern range, 32 miles from London by the Great Northern Railway, and 14½ N.W. from Hertford. The town consists of several streets, and has in recent years been wonderfully improved in appearance, a large number of new houses having been built in the vicinity of the railway station. A good supply of water has also been obtained. The principal trade is in corn and malt. Straw-plait is made, and there are some breweries. The church is a handsome edifice, built upon the foundations of a more ancient structure. The south porch is a remarkably fine specimen of Gothic architecture in the Perpendicular style, and there is a font of the same character; also numerous sepulchral monuments and brasses. The whole building has been restored, and a new church was erected in 1865 at the expense of the Rev. G. Gainsford. There are places of worship for all denominations of dissenters, and a cemetery, seven acres in extent. The town also contains a modern town-hall, corn exchange, infirmary for North Herts and South Bedfordshire, workmen's hall, with a large room for meetings, news-rooms, &c., and some good schools. Near the town are some lavendar farms. The name of Hitchin is derived from the Saxon *Hicce* or *Hitche*. The population in 1881 was 8434.

HITOPADE'SA (Sansk. *hita*, good; *upadesa*, advice) is the charming collection of fables in the ancient Sanskrit which, or to speak more correctly, the originals of which, permeate the folk-lore and fairy tales of the whole Aryan family of nations. The Hitopadesa bears marks of a comparatively late date upon it, in fact it is founded upon the older collection of the *Pancha Tantra*, but the fables themselves are probably of vast antiquity. They are some of them told even in the *Mahabharata*. The tales are connected by a thread of narrative, which gives them a purpose, namely, the instruction by a certain Vishnu-Sarman of unruly princes who cannot be directly taught, but who prove amenable to the subtle innuendos of his appropriate fables. Also, in true Oriental fashion, one tale grows out of another, or forms an episode to another in the most elegant and unconstrained manner—a method repeated many centuries later, but with equal success and charm, in the "Arabian Nights." Every now and again the gist of what has gone before is summed up in a pithy and sententious moral, so that there shall be no doubt about the true application of the suggested teaching. The best edition of the Hitopadesa in the original is that of Schlegel (Bonn, 1829). English translations are those of Sir W. Jones (1807), and Johnson (1848).

HIVE. See BEE.

HLID'SKIALF ("swaying gate"), the throne of Odin and his consort Frigga, placed on an eminence so high above Asgard (the Norse Olympus) that the All-Father could thence descry the whole universe and overlook the doings of gods, men, elves, and giants alike.

HOANG-HO or YELLOW RIVER. See China.

HOAR-FROST, a congelation of moisture, formed by the temperature of the atmosphere suddenly falling below the freezing-point (32° Fahr.); or by the sudden refrigeration of substances by which their surface moisture is converted into icy particles. Perhaps the face of nature never assumes a more picturesque or pleasing appearance than on the mornings of a strong hoar-frost, when the fogs have disappeared and the bright azure sky gleams over the productions of the earth. But on the return of the solar warmth the scene rapidly changes, and the spicular and granular particles of which icy dew is composed are gradually transformed to their original moisture. The greatest deposition of hoar-frost occurs in broad valleys, open to a wide expanse of sky for radiation.

The circumstances of terrestrial radiation, chiefly, but not exclusively, nocturnal, under which the aqueous vapour of the atmosphere becomes condensed upon the bodies in contact with it, are discussed and explained at some length in the article Dew. If the temperature of those bodies be reduced below the freezing point of water hoar-frost is produced, the most characteristic form of which differs from dew only "by being frozen in the moment of deposition, and therefore accreting in crystalline spiculæ." But it occasionally happens that after the globules of water constituting dew have been deposited they are frozen, and become another form of hoar-frost. This latter is truly frozen dew, but the popular description of true hoar-frost as frozen dew is totally inaccurate. It is water deposited in the solid form, not water deposited as such and then frozen. The latter, if it is frozen rain, or a frozen wet surface, takes the dangerous form, happily rare in England, of Verglas.

From a series of experiments on the formation of hoar-frost on various substances, made at the Greenwich Observatory, it was found that the spikes of hoar-frost increased in magnitude in proportion to their distance from the root or stem of grass and leaves, and that the vegetable heat in that region of the plant counteracted the reduction of temperature by radiation. Glass raised an inch high above the ground was covered with spikes one-sixteenth of an inch in length, and all arranged horizontally at the edges. On metals, such as copper, lead, zinc, tin, iron, &c., there were neither laminæ nor spikes of any kind; but tin, raised an inch high, was a little whitened at the edges. On sand there were spikes one-fourth of an inch in length. Chalk was covered with a mass of spikes of about the same length. Of cotton wool every fibre was incrusted with a beautiful fringe of hoar-frost, and there were also a few spikes of ice. Raw wool was richly clustered on each fibre, so as to be about six times its own size; the spikes were three-fourths of an inch in length, and piled one upon another. Sawdust was very beautifully covered with spiculæ in fans, formed by several spikes emanating from the same point at all angles greater than 30 degrees with the horizon. These spikes were connected with each other by lateral spikes or bands, the whole forming the appearance of a fan, whose extent was 120 degrees.

In England, even in the mildest parts, vegetation is liable to be affected at night, from the influence of radiation, by a temperature below the freezing point of water every month of the year, even in July and August; and spring vegetation is often checked by hoar-frost, unless the productions are protected by slight layers of straw or a fire lighted to windward during cold clear nights, the smoke of which, hovering above the plants, checks the radiation, which is the cause of the hoar-frost.

The aspect of our windows on a frosty morning (Plate II.) is very familiar to all of us. Some of the lovely feathering forms which hoar-frost takes upon flat surfaces, such as window-panes, are shown in Plate I., figs. 1–10. But along an edge, as the edge of a blade of grass, &c., hoar-frost takes the spicular form already spoken of; along the top edges of the post and the edges of the stone which serve to exemplify figs. 11, 12, decoration in the form of a star. This post had a chamfered top all round, and the little spicules follow both the upper square, A B C D, and the lower square, E F G H. A rough log with the bark on, an iron bracket, a fallen leaf lying face downwards, and another face upwards, are given in Plate II., figs. 19–22, as familiar and easily observed examples. The spicules follow the windings of the bark of the log, or the edges of the star, or the veins of the leaf with great exactitude. It will also be observed that they are largest when the edge is keenest. On the sharp under ribs of the leaf which has turned over they are much larger than on the surface of the leaf which lies face upwards. A section of the iron work is given in fig. 20 to show the way in which the spicules frequently stand out; or there may be two rows of them at an angle, as in the star and the chamfered post (figs. 11, 12). A row of spicules is also shown on an edge against a dark background in fig. 23; and one spicule (fig. 24) is magnified to show its structure. The remainder of Plate II. is taken up with examples of the way in which hoar-frost, like dew, depends on radiation. The spicular hoar-frost on the log is thicker at the top than at the sides, and that at the upper part of the star in fig. 11 is thicker than that at the lower part, simply because the former have the greater opportunities of radiation. An observed example is sketched in fig. 25, where all the longer shoots of some young wall-trees were nipped by hoar-frost, and it was found that those of the same age which happened to fall within a perpendicular line let fall from the coping escaped. The slight protection against vertical radiation afforded by the coping had been sufficient to save them. So also a bough (fig. 17) will be usually found to have free patches without frost, and on examination these will be seen to lie immediately under other boughs, which, by crossing above, have shielded them from parting with their heat by radiation, so that hoar-frost has not been able to be deposited. The same occurs on a gate or railed fencing (fig. 26), where not only is the upper rail A B more thickly frosted than the lower rail C D, but also the vertical fencing, by checking lateral radiation of the latter, crosses it with square patches almost bare of hoar-frost. This effect is somewhat aided, of course, by the warmth of the fencing. Protection by warmth of neighbouring objects is well exemplified on any iron railing, such as the gateway in fig. 18, for instance. Here the rails, A B, C D, next the side walls will probably escape altogether by being gently warmed through the radiation of the side walls into the cool night air; so also each pillar will protect the rail next it (E and F), while the rest of the rails will be frosted as at G, H, and onwards. But the low wall in which the railing is fixed also has its warmth, acquired during the day, and imparted to the rails themselves and to the air during the night; accordingly we find that up to a line I K or L M these rails are protected. If there are thicker ones they, as conducting more warmth from the wall, will escape hoar-frost to a point a little higher, as along N O, P Q. Looking along the broad expanse of glittering hoar-frost on the grass of some fine park, we cannot help observing how beneath each tree is usually a circular patch of verdure, all the greener for the contrast with the brilliant whiteness around. The circle, as at B D, F H, beneath the trees in fig. 16, is of the same diameter as the widest branches of the tree-top. This protection is not due to warmth, however, but simply to the stoppage of radiation from the earth into the clear wintry sky. This little patch of earth has therefore never sunk so low as to reach the hoar-frost point.

An odd effect is shown in fig. 27, which is of very common occurrence. If a window, say of a shop, has been frosted pretty thickly, and the warmth from within has

begun to thaw the hoar-frost, bottles or other articles placed close to the glass will, by protecting spaces of their own size on the panes, leave frosty images of themselves clearly drawn, which will gradually disappear as the glass becomes warmer.

HOAT'ZIN (*Opisthocomus cristatus*) is a remarkable South American bird, the position of which in a system of classification is somewhat puzzling. It is most generally classed among the game birds (GALLINÆ), of which it forms a distinct family, Opisthocomidæ. The hoatzin is nearly as large as a peacock, which it resembles in many of its movements. Its plumage is tawny brown, with numerous white spots and streaks upon the wings and tail; its breast is yellowish-white; the naked skin about its face and throat is bluish; and the elongated slender feathers which form the crest are white on one side and black on the other. The bill is large and convex, with the nostrils pierced in the middle of the upper mandible. The mandibles are denticulated within the margins. The wings are short and rounded; the tail is long. The legs are long, the feet large and strong, the tarsi reticulated and the toes scutellated, the hind toe lying on the same plane with the other toes. Peculiarities, unique among birds, occur in the sternal and digestive apparatus. The hoatzin is a native of Brazil and Guiana, where it is known as cigano or gypsy. It gives preference to woods bordering rivers and flooded savannahs, rather than to higher grounds. It lives in considerable flocks, and feeds much on the leaves of the arborescent arum (*Caladium arborescens*). The flesh of this species is not in high repute, having a rank musky flavour and smell; and hence medicinal properties have been attributed to it by the natives, who nevertheless deem it a bird of ill omen. With reference to its flesh Mr. Bates ("Naturalist on the Amazon") says:—"If it be as unpalatable to carnivorous animals as it is to man, the immunity from persecution which it would thereby enjoy would account for its existing in such great numbers throughout the country." It is never domesticated nor ever even seen on the ground. Its cry is a harsh grating hiss. The hoatzin is polygamous, and builds its nest in the lower part of a tree; the hen lays three or four eggs, white in colour, blotched and spotted with red.

HO'BART (or as it was formerly called and sometimes wrongly spelled, *Hobarton*), the capital of Tasmania, is situated on the south-east side of the island, near the mouth of the Derwent, and is connected by telegraph with Launceston and Melbourne. It occupies a commanding and extremely picturesque position, at the head of a sheltered bight called Sullivan's Cove, about 17 miles from the sea, and covers about 1280 acres of gently rising ground, backed by an amphitheatre of lofty and well-wooded hills, the summits of which rise to the height of 4000 feet. The city is laid out on a regular plan; the streets cross each other at right angles, are airy, wide, and macadamized or flagged. There are numerous public buildings, of which the government house (a handsome palatial pile of the finest white freestone, on the banks of the Derwent) and government offices, the houses of Parliament, the town-hall, post-office, museum, and the banks may be instanced as the largest. The botanic gardens have an area of 21 acres. There are about forty places of worship for various denominations, including the Cathedral of St. David's, the town being the seat of a colonial bishopric, a synagogue, a Roman Catholic cathedral, and a Wesleyan "Centenary" chapel, some being of considerable architectural merit. Attached to the town-hall is a public library well supplied with upwards of 8000 volumes. There are also a large number of schools, public charitable institutions, hotels, manufactories, markets, baths, &c. Hobart is lighted with gas, and plentifully supplied with water from a spacious reservoir on the Sandy Bay rivulet, about a mile distant. The manufactories comprise tanneries, foundries, saw and flour mills, and breweries of great extent, and a considerable quantity of jam is made for export. Many of the houses are of very good construction, and some are tasteful and elegant. There are three patent slipways in the harbour, which is excellent, being well sheltered from all winds. The tide is irregular, rising at times 7 or 8 feet, but usually only 4 or 5 feet. The population in 1885 was 25,000. On either bank of the Derwent, both above and below the city, are numerous beautiful villas. The distance from Melbourne is about 800 miles; from Sydney, 800; from Adelaide, 1000; and from the English Channel, 12,180. During the summer months the re-invigorating nature of the climate attracts large numbers of visitors from Australia to Hobart. The mean temperature is said to be 55·41° Fahr. The corporation consists of nine aldermen including the mayor. The city was founded by Colonel Collins in 1804, and named after Lord Hobart, who was then colonial secretary.

HOB'BEMA, MEINDERHOUT, one of the glories of the Dutch school of landscape painting, was born in 1638 and died in 1709. Little is known of him, but it is almost certain that he was a pupil of Ruysdael, and he painted so much in his master's style (only that in the opinion of many he surpassed him) that during the supremacy of Ruysdael's fame and the undeserved neglect of Hobbema, his signature was often effaced from his pictures and Ruysdael's monogram fraudulently substituted. The number of Hobbema's works has in this way been unjustly reduced; but the artist has been revenged by time, and an undoubted Hobbema, on account of its rarity no less than its merit, is now worth an almost fabulous sum. The National Gallery possesses a few Hobbemas, but though fine they are not equal in value to the masterpieces in the Duke of Westminster's collection at Grosvenor House, London, nor to the famous "Dutch Cabin" of Munich and the "Oak Forest" of Berlin. The surpassing excellence of Hobbema, though long undervalued by the general public, was of course always recognized by true landscape artists, and the famous "Old Crome" of Norwich, himself founder of a manly English school of landscape, died with his name upon his lips—"O Hobbema, Hobbema, how I do love thee!"

HOBBES, THOMAS, the "Philosopher of Malmesbury," was so called from a small town in Wiltshire, where he was born, 5th April, 1588, somewhat prematurely, from the circumstance of the portentous Armada of Spain having affrighted his mother. His father was the minister of the town. He went early to Oxford, and at the age of twenty undertook the office of travelling tutor to the heir-apparent of Cavendish, Lord Hardwicke, afterwards Earl of Devonshire. He travelled with his pupil through France and Italy, and he resided in the family for several years after their return to England. During this period he enjoyed the friendship of Bacon, Lord Herbert of Cherbury, Ben Jonson, and other distinguished men of the time. In 1628 he published at London a little poem on the "Wonders of the Peak of Derbyshire;" and there also about the same time his translation of Thucydides. The merit of this translation lies chiefly in the simplicity and force of the language, in which respect it bears a creditable resemblance to the original. His object in publishing it was to bring historical warnings to bear on the minds of his countrymen, then in the ferment of civil troubles. To dissipate the grief occasioned by the early death of his late pupil he went in 1628 to France with another, Sir Gervaise Clifton's son. He there devoted much time to mathematics; but in 1631 he returned to the Cavendish family and accompanied the young lord on the grand tour, in the course of which, at Pisa, he became acquainted with Galileo. In 1637 he returned with his lordship to England; but on the breaking out of the Civil War he again quitted England for Paris, and there mixed in congenial society. M. Sorbière,

Father Mersenne, and Gassendi were among his friends, and Descartes became his correspondent. At Paris, in 1646, he published his work "De Cive." While still at Paris he had printed in London—where the press was free, *regni novitas* notwithstanding—in 1650 his treatises on "Human Nature" and "De Corpore Politico;" and in 1651 his great work, quaintly designated "Leviathan." The permanent value of "The Leviathan" is well shown by its publication in 1885 in Morley's Universal Library. "The Leviathan, or the Matter, Form, and Power of a Commonwealth, Ecclesiastical and Civil," is the title of this famous book. It is justified by Hobbes' conception of the state as a vast living body, a huge animal, whose life arose from men's need of common action for common safety, and whose death would be brought about by mutual jealousy and bad faith, ending in state-suicide, *i.e.* civil war. The natural condition of men is individual strife, says Hobbes: out of their needs arises the state, with its dominion of reason, peace, security, and good-will. The ruler of the state may be a monarch or an assembly, but the monarchy is the more perfect form, as involving the stricter unity. With the state rests the distinction of right from wrong: what it sanctions is good, what it punishes is bad; what it believes is true religion, what it condemns is superstition. In fact Hobbes' standard in morals is the will of the monarch or of whatever other shape the supreme authority of the state may take. The work at once made his fame as the greatest thinker since Bacon, but it also at once raised hosts of enemies on both sides, Parliament-men and Royalists. Although attached to the cause and fortunes of the exiled royal family, and intrusted about this time with the instruction of the prince, afterwards Charles II., in mathematics, his loyalty and religion were virulently impeached on account of the assumptions in his works, especially at the close of "The Leviathan," where he speaks of the obedience due to rulers *de facto*, and of the supremacy of the sovereign in ecclesiastical matters. To escape assassination he found it convenient to return to England, then under Cromwell, whom his principles allowed him at least to obey. Always fortunate in his intimacies, he now numbered among his friends Harvey the discoverer of the circulation of the blood, Selden the jurist, Cowley the poet, and Vaughan, afterwards chief-justice of the Common Pleas. In 1653 he finally returned to the family of Lord Devonshire, who settled upon him a small pension. In 1654 he published the letters on "Liberty and Necessity," detailing the controversy which he had had with Dr. Bramhall, afterwards archbishop of Armagh, while they were in France; and about the same time he commenced a polemical correspondence with Dr. Wallis, who was professor of mathematics at Oxford, in the course of which Hobbes had the mortification of having not only his geometrical positions, but his loyalty impugned, though he took an opportunity of recriminating on Wallis, who had gone some lengths with the republicans. From this contest, long persisted in, Hobbes finally retreated without glory. At the Restoration in 1660 he regained some portion of the royal favour, and received a pension of £100 a year out of the privy purse; but the popular voice, as represented in Parliament and convocations, still ran against him, and in 1666 his "Leviathan" and "De Cive" were censured by Parliament. Soon after he was alarmed by the introduction into the House of Commons of the bill for the suppression of atheism and profaneness, which some were officious enough to tell him would be enforced against him. In 1672 Hobbes wrote his own life in Latin verse; and soon after his translations of Homer into English verse appeared in detached parts. This was the amusement of his old age. It might on that account claim exemption from criticism, if the verse were not, as Pope said it was, below criticism. On this sharp critique Sir W. Molesworth remarks that some may, however, possibly find that the unstudied and unpretending language of Hobbes conveys an idea of Homer less remote from the original than the smooth and glittering lines of Pope and his coadjutors. In 1664 Hobbes began to study the law of England, "looking over the titles of the statutes from Magna Carta downwards, and leaving no one unread." He also diligently read over Littleton's "Book of Tenures" and Sir E. Coke's "Commentary;" in the latter, he says, he found much subtlety, not of the law, but of inference from the law. Some fruit of this study is seen in the "Dialogue between a Philosopher and a Student of the Common Law. This tractate is imbued with high prerogative notions, but contains many just strictures on the abuses of the law. It was published in 1678, together with his "Decameron Physiologicum," or ten dialogues on natural philosophy; and his "Rhetoric," a free translation of that of Aristotle. "The Behemoth" (Monarch of the Land), containing an account of the Civil Wars, was published after his death. It told too much truth, and distributed blame too freely and impartially, to be acceptable to either of the great political parties of the day. Hobbes died at Hardwicke in Derbyshire, 4th December, 1679, aged ninety-one.

HOB'BY (*Falco subbuteo*) is a small British species of FALCON, closely resembling the peregrine. It usually measures from 12 to 14 inches in length; the plumage of the upper parts is grayish-black or bluish-gray, the quill feathers of the wings are black, and those of the tail grayish-black indistinctly barred with a lighter tint. The lower part of the body is yellowish-white, with dark brown patches; the beak is bluish, the cere greenish-yellow, the feet yellow, and the claws black. The hobby has been met with in many parts of this country, to which it is a summer visitor, but is by no means an abundant British bird. It is found in all parts of the continent of Europe, and also occurs in Northern Africa, and probably in most parts of Asia, as specimens have been obtained from Siberia, India, and even from China. It usually inhabits wooded districts, where it builds its nest in a high tree. Its powers of flight are very great, its wings being so long as to reach beyond the end of the tail when closed. In a state of nature its favourite prey appears to consist of skylarks, in pursuit of which it manifests great perseverance, while the unfortunate lark exhibits wonderful dexterity in avoiding the fatal swoop of its pursuer. The hobby is also sometimes trained to fly at larks, quails, and snipe. Besides birds insects form a large part of its food.

HOCHE, LAZARE, an eminent French general of the time of the Revolution, was born in 1768 near Versailles, of very humble parentage, and enlisted in the French Guards at the age of sixteen. During the revolutionary war he served in Flanders as a lieutenant under Dumouriez. Having distinguished himself he was rapidly promoted, and at the age of twenty-four was made general in command of the army of the Moselle. Upon incurring the displeasure of St. Just, however, he was thrown into prison at Paris, when his life was preserved by the timely overthrow of Robespierre in July, 1794. The Convention restored him to his rank, and sent him against the insurgents of La Vendée.

Hoche now conceived the bold idea of effecting a landing in Ireland, and a fleet having been equipped at Brest with great secrecy, he embarked his troops in December, 1796; but being separated by a storm from the rest of the fleet, he was obliged to return to France without having effected anything.

In the quarrel which took place between the Directory and the Legislative Councils Hoche took the part of the executive, and began to direct some of his forces towards Paris in order to support the Directory. For this he was denounced by the councils, and Bonaparte meantime having offered the support of his own army of Italy,

the Directory declined Hoche's services, and made use of Augereau to effect the *coup d'état* of Fructidor. Hoche returned to his headquarters at Wetzlar, where he was seized by a sudden illness, of which he died, 18th September, 1797. The symptoms of the disease gave rise to suspicions of poison. His life has been written by Rousselin in two volumes 8vo.

HOCK-TIDE, among our mediæval ancestors, a day set apart for sports and public rejoicings in celebration of the slaughter and expulsion of the Danes, by which the country was freed from their oppression. It was the second Tuesday after Easter, and formed a kind of epoch or period from which leases or other written agreements were dated.

HO'CUS PO'CUS, the well-known juggler's catchword, whence our term *hoax* (cheating trick), is said by Tillotson to have been a deliberate mockery of the sacred words *Hoc est Corpus* of the Roman Catholic mass, which the priest utters when he consecrates the holy wafer, and thus in Roman Catholic doctrine converts it into the absolute body of our Lord. In the highly wrought state of feeling at the time of the Reformation such an insult would be only too probable. The indecency with which men used their new freedom from Rome under Henry VIII. to profane the older worship was indeed almost without limits. The mystery of transubstantiation was mocked in songs and on the rude stage of the time, and rough horse-play was even carried into the churches at mass-time. It was this profane license that brought on the rigour of the "Six Articles." Scholars, however, have lately thrown doubt upon this derivation, and most men would willingly believe that *hocus pocus* is either a phrase of no meaning invented for its sham-Latin appearance, or that it comes from the Welsh *hoced pwca*, an elfish trick.

HOE, HORSE-HOE. The hoe is an instrument used in gardens and in the fields for loosening the earth and destroying the weeds between plants. It has various forms. The most common hoe consists of a blade or flat piece of iron, with an eye in which a handle is inserted at an acute angle with the plane of the blade. This hoe is used by striking the edge of it down into the ground, and the earth is moved by drawing the handle towards the workman. Another hoe has the handle at a very obtuse angle, and is used by pushing it forward and cutting off the weeds an inch or less under the surface of the ground. Hoes are made of different sizes and shapes, according to the work which is to be done. When the earth is to be stirred between plants which are very near to each other, the hoe is narrow and pointed, so that the smallest weed may be taken out close to the growing plant. When the distance is considerable the hoe is wide, and sometimes compounded of several hoes, in order to stir a greater width of earth at once.

One of the greatest improvements in practical agriculture has been the introduction of the hoe into the field for every kind of crop. Pease and beans were probably the first crops which were sown in rows for the purpose of hoeing the intervals; potatoes, turnips, and carrots were probably the next, and the good effects produced on these crops by stirring and hoeing have led to the drilling of every other kind of produce which is apt to be injured by weeds. Hand-hoeing not having been found sufficiently expeditious on a large scale, a hoe was invented of a larger form, drawn by a horse.

A variety of horse-hoes have been invented of more or less complicated forms; but the object of them all is the same—viz. to stir the ground between the rows and destroy the weeds as fast as they appear. The horse-hoe is now chiefly used in the cultivation of pease, beans, potatoes, cabbages, turnips, and carrots.

A horse-hoe, in which a framework 8 or 10 feet wide, supported on large wheels, carries twelve to twenty hoes attached to coulters hanging at intervals of a few inches from each other, is now used in the cultivation of drilled corn crops during the earlier stages of their growth. The width cultivated and number of intervals hoed at once correspond exactly with the width and rows which had been sown at once by the drill, so that it only needs that the hoe be placed on the exact rows which were sown at one and the same time, and any crookedness or unevenness in the row will be followed by the hoes. With a hoe of this kind one horse will cultivate from 6 to 8 acres a day.

The effect of hoeing is remarkable in very dry weather. Although the stirring of the soil would seem to extract what little moisture there might be in it, and the weeds wither on its surface, it soon appears that, on the contrary, moisture is attracted or produced, and the plants which drooped before appear refreshed and invigorated.

The operation of hoeing cannot be performed too soon after the plant has shot out its roots, because the ground may then be stirred very near the young plant without danger, and the roots will spread readily in the newly stirred soil.

The best time for hoeing stiff soils is when they are neither wet nor dry; when the surface is slightly caked, but there is moisture below it, and when the weather is dry after some rain. Light soils can be hoed at any time, and require it oftener than the heavy, especially in showery weather.

HO'FER, AN'DREAS, a Tyrolese patriot, was born at St. Leonhard, 2nd October, 1767, and in 1809 headed an insurrection against the Bavarians and French, by whom his country had been occupied. Three times he defeated the armies of the invaders, and for a while administered the internal affairs of the liberated province; but another army advancing against him, he was ultimately compelled to seek refuge in the mountains, when he was betrayed into the hands of the French, and was shot at Mantua by the order of the Emperor Napoleon I. on 20th February, 1810. In 1823, his family having been ennobled by the Emperor of Austria, his remains were removed from Mantua to Innsbruck, where they were buried with all honour; and in 1834 a marble statue was erected over his tomb. The story of Hofer has been made the subject of more than one tragedy, and his name is still held in great reverence by his countrymen.

HOFF'MANN, ERNST THEODOR WILHELM (or *Amadeus*, the name he assumed instead of Wilhelm), one of the most original writers of Germany, was born 24th January, 1776, at Königsberg, in East Prussia. Hoffmann, like our own Fielding, was an excellent magistrate, and highly esteemed in Warsaw, where he served. On the entry of the French troops into that town in 1806 he found himself at once without employment, without fortune, and without the prospect of any office in his then distracted native country. He determined boldly to make his many accomplishments serviceable to his support. He taught music, wrote articles for the *Allgemeine Musikalische Zeitung* of Leipzig, and accepted in 1808 the situation of musical director of the theatre at Bamberg, and later at Dresden. After the downfall of Napoleon he was appointed to a seat in the royal justiciary court at Berlin, which he filled with great credit to himself as a judge till his death on 24th July, 1822.

Hoffmann was small and weak of body, but for many years he laboured with extreme ardour. Besides his professional acquirements, which were highly estimated by his colleagues, he composed the music and text of many operas: the first was the music only to Goethe's "Scherz, List, und Rache" (Jest, Trick, and Revenge), which was performed at Posen in 1800. He also produced a number of caricatures, highly popular at the time, of the foreign invaders of his country, and especially of Bonaparte. The first series of his fantastic, weird, and wholly original and

delightful tales appeared at Bamberg in 1814, "Phantasiestücken in Callots Manier;" and he continued to write similar tales till his death. They are all distinguished by a fertile wildness of imagination, considerable humour, vivid descriptions of the beauties of nature, much insight into the inconsistencies of the human character, and sly sarcasm. Closely analogous to Hoffmann in our own language are the equally remarkable "Tales, Grotesque and Arabesque" of Edgar Allan Poe, excepting Hawthorne the most original work produced in America. An edition of Hoffmann's collected works in twelve vols. appeared 1871–73. A brief account of the author, with a translation of one of his shorter tales, is given by Carlyle in his "German Romance" ("Miscellanies"), which did so much to open the eyes of Englishmen to German literary beauties. A more comprehensive graphical memoir and a tolerably complete translation of these "weird tales," as they are justly called, is that of J. T. Bealby of Cambridge (two vols., London, 1884).

HOG. The wide dispersion of the domestic hog and its usefulness to man need no comment. It is omnivorous, and thrives on every kind of food, vegetable or animal. The sow may bear two litters in the year, each consisting of eight, ten, twelve, or fourteen young, sometimes more. The domestic hog (*Sus scrofa*) is descended from two distinct wild stocks, the wild boar and the *Sus indica*, a species which is not known now in the wild state. The present article deals only with the domestic breeds, the wild animals being reserved for the article PIG. Pigs of the *Sus indica* type are best known under the form of the Chinese breed. This breed, though small, is remarkable for fattening rapidly, and also for productiveness; and when by judicious crossing the size is increased, a great point is attained. The Chinese pig is short in the head, with ears pricked up and pointing backwards, very wide in the cheek, high in the chine, and short in the leg; the young pigs make delicate roasters at a month old, and, when dairy-fed, excellent porkers at about three months old. The breed in this country nearest to the Chinese is the Suffolk. These pigs are generally white, with pointed ears, broad chest and loin, and a compact outline. The suckling roasters and the porkers are excellent, and they make fine bacon hogs at twelve or fifteen months old. The Japan or masked pig is considered to be a domesticated variety of *Sus indica*. Its appearance is exceedingly remarkable; it has a short head, broad forehead and nose, and great fleshy ears. The skin of the face is deeply furrowed, and thick folds of skin, compared by Darwin to the plates of a rhinoceros, hang about the shoulders and rump.

The Tame Boar (*Sus scrofa*).

Formerly many breeds descended from the wild boar existed in England and throughout Europe. The old Irish greyhound pig, one of these breeds, has often two curious appendages attached to the corners of the jaw; they are about 3 inches in length and covered with bristles, and also occur in the Normandy pigs. The boars of all the domestic breeds have shorter tusks and are more sparsely covered with bristles than the wild boars. The older breeds are now replaced by improved breeds crossed with the *Sus indica* form.

The Essex breed approaches the Neapolitan, and is probably derived from the latter. Some are black and white, but the pure breed is black. This breed is admirable, and, when directly crossed with the Neapolitan, produces an intermixed progeny of superior qualities, fattening at an early age and to an astonishing degree, with delicacy of flesh. The true Neapolitan hog is black, without any hair, very plump, with sharp ears. No breed can excel it in readiness to fatten; but it is tender, and winter litters are liable to perish from cold. It is very valuable as a cross with some of our hardier sorts, especially with the Berkshire, a noted race in the present day in consequence chiefly of this admixture of blood. Indeed, a mixture of the Berkshire, Chinese, and Neapolitan breeds may by careful selection and attention to the principle of not inter-breeding in one strain too far, be brought to the highest degree of perfection. A remarkable deviation from the ordinary type is displayed by the solid-hoofed pigs, which have been observed, says Darwin, in various parts of the world from the days of Aristotle to the present time. Pigs were domesticated by prehistoric man, the remains of two domestic breeds being found in the Swiss pile-dwellings, which belong to the later stone age.

Colour is chiefly a matter of fancy, but black pigs have the thinnest skin, and suffer less from the sun in summer, and hence they are less liable to cutaneous diseases. Experience teaches that when sows and boars are too nearly related the fecundity diminishes considerably. The very large breeds are not generally considered so profitable as the smaller ones, as they do not so soon come to maturity, and cannot be profitably put up to fatten till they are eighteen or twenty months old. For delicate bacon the hogs killed at a twelvemonth old, and weighing from ten to twelve score, are much preferred. It is a great mistake to suppose the hog loves dirt. If it can keep itself clean it will do so, and its wallowing in the mud arises generally from heat and itching of the skin in warm weather, which is relieved by rolling in the cold mud. If hogs have plenty of straw and clean water they will never be dirty; and nothing makes them thrive so quickly or pleases them more than being washed and curried regularly.

The fat of the hog, which is produced in a thick layer under the skin, is an article of commerce and of various uses under the name of lard. The skin is made into leather, which is particularly esteemed for saddles. The bristles are much used for brushmaking. In order to

manage hogs profitably a regular system must be pursued. Proper sties for breeding sows, boars, feeding-hogs, and porkers must be constructed, with due attention to comfort and cleanliness. Regularity in feeding, attention to the quality of the food, according to the purpose designed, increasing it from less nutritious articles to a full diet, from boiled potatoes mixed with bran, to peameal, barley meal, skimmed milk, &c., are points of importance. Conveniences, as boilers and outhouses, for the preparation and storing of food, are also essential, and so is due cleanliness of the troughs.

HO'GARTH, WILLIAM, the celebrated satirist and painter, founder of the English school of painting, except so far as the gloomy allegories of Sir James Thornhill may dispute that honourable title, was born in the parish of St. Bartholomew, London, on the 10th of December, 1697. His father, originally a schoolmaster of Westmorland, was then established in London as a printer's reader or corrector of the press. The son was apprenticed at an early age to Ellis Gamble, a silversmith, who had a shop in Cranbourn Alley, Leicester Square, and Hogarth was brought up as an engraver of crests and ciphers on metal. In 1718, however, when the term of his apprenticeship had expired, he forsook silver-engraving for the higher branch of the art on copper, and procured from the booksellers more congenial employment. But of real artistic training he properly had none, and was always to the last degree impatient of academic work, and eager to draw and paint from life itself. Nothing could be too vigorous or striking for his pencil. Passing over some early and insignificant works which have been discovered, his first production of importance in this direction was the twelve large plates executed for an edition of Butler's "Hudibras" in 1726, which had been copied for subsequent editions of that poem; and though Hogarth engraved many book-prints about this time, he found engraving such a miserable profession that he got sometimes for his plates a very little more than the value of the copper; he therefore adopted portrait painting as his main support. In this branch of art he did much better; he ventured to take a wife in March, 1729, and married the only daughter of Sir James Thornhill the painter, in spite of her father's opposition. His marriage seems to have acted as a great stimulus to his exertions, for in a very few years from an obscure engraver we find him developed into an excellent painter, without a rival in his own satirical sphere, and with few equals in the mere technical manipulations of his art. Oddly enough, though quite incapable of flattery, it was as a portrait painter that he first began to earn a moderate subsistence. Captain Coram, Garrick, Handel, and Wilkes are good examples of his almost photographic accuracy and of his just colouring. Of his several moral series of excellent pictures, the first to appear was the "Harlot's Progress" in 1733, the engravings of which, in six plates executed by the artist, were issued in 17?4. In these well-known pictures the stages of a trag. story taken from every-day life are depicted with a grim realism that comes home to every man. They quickly attracted widespread attention, and the introduction of the portraits of some well-known public men brought a rush of subscribers, and Hogarth's fame as a painter became firmly established. The "Harlot's Progress" was followed in 1735 by the "Rake's Progress," in eight pictures, and during the next few years by the "Strolling Actresses in a Barn" (1736); the "Distressed Poet" (1738); and the "Enraged Musician" (1741). Another admirable series of paintings, with the subjects drawn from the higher ranks of society, appeared in 1745 entitled "Marriage à la Mode." In 1746 he painted a portrait of Garrick as Richard III., and among his more important works of the next few years we may enumerate his "Industry and Idleness," in twelve plates (1747); the "Gate of Calais" (1749); the superbly ridiculous "March to Finchley" (1750), which so roused the ire of George II. with its mockery of his guards; and the "Four Prints of an Election" (1755), all of which, some originally paintings and some not, were issued as engravings. The "March to Finchley" was sold by lottery; and the kind-hearted artist gave some tickets to the Foundling Hospital. Few were sorry when the winning number proved to be among those tickets, and the picture took its place beside Hogarth's masterpiece of portraiture, Captain Coram, the founder of the Institution. In 1745 he had painted and exhibited his own portrait, placing in the corner a curved line, which he entitled the line of beauty. Some inquiry arose as to the meaning of this, and in 1753 he published his "Analysis of Beauty." This book was severely criticised at the time of its appearing, and the principles it promulgates are now generally regarded as erroneous. In 1757 he was appointed sergeant painter to the king. He died at his own house in Leicester Square, 26th October, 1764, and was buried in a vault at Chiswick, where he had a villa in which he generally resided in the summer. "Hogarth," says Walpole, "resembles Butler; but his subjects are more universal, and amidst all his pleasantry he observes the true end of comedy—reformation." There is always a moral to his pictures. Sometimes he rises to tragedy, not in the catastrophes of kings and heroes, but in marking how vice conducts insensibly and incidentally to misery and shame. He warns against encouraging cruelty and idleness in young minds, and discerns how the different vices of the great and the vulgar lead by various paths to the same unhappiness. There are several sets of Hogarth's works published. The best is that of Nicholas (three vols., London, 1820–22). His famous series of pictures, the "Marriage à la Mode," and a fine tragic painting in a lofty classical style on the subject of Sigismunda with the heart of her lover sent her by her inhuman father Tancred (a story from Boccaccio's "Decameron"), and the portrait of Hogarth himself, already referred to, are in the National Gallery. Other important works are to be seen in the Sloane Museum, the Foundling Hospital, and the National Portrait Gallery. The fine portrait of Handel exhibited at the Handel festival of 1883 was pronounced by Ruskin to be, as alleged, veritably a work of Hogarth's.

HOGG, JAMES, a Scottish poet, generally known by his poetical name of "The Ettrick Shepherd," was a native of Ettrick Forest in Selkirkshire. According to the last of the numerous accounts which he gave of his life, he was born in 1772, on the 25th of January, the anniversary of Burns' birthday. But the parish register of Ettrick records his baptism as having taken place on the 9th of December, 1770. His father, having saved a little money, took the lease of a farm in Ettrick and commenced dealing in sheep. In the course of a few years, however, he lost his whole property, and Hogg, who was only seven years of age at the time of his father's bankruptcy, was in consequence obliged to go to service with a neighbouring farmer as cowherd. After serving a number of masters as a shepherd, Hogg entered at Whitsunday, 1790, into the service of Mr. Laidlaw of Blackhouse in Yarrow, father of William Laidlaw, the confidential friend of Sir Walter Scott. There he remained for nine years, had access to a considerable collection of books, and received every facility for the cultivation of his poetical genius. It was through William Laidlaw, too, that he was introduced to Sir Walter Scott, who was greatly interested in Hogg's character and history, and was ever after one of his best friends. It is difficult to say at what period the Shepherd's poetical genius first began to display itself. His first printed piece, entitled "The Mistakes of a Night," appeared in the *Scots Magazine* for October, 1794. In 1801 he published hastily a small collection of his verses, and in 1807 a volume of his songs and poems, of greatly superior

merit, appeared under the title of the "Mountain Bard," the profits of which, and of a treatise on the diseases of sheep, amounted to £300. He had previously lost all his savings as a shepherd in a sheep-farming speculation in the island of Harris; but undeterred by this failure, he now took a farm in Dumfriesshire, which proved a ruinous concern, and in three years left him penniless. Failing to obtain employment as a shepherd, he took his plaid about his shoulders, he says, and set off for Edinburgh in 1810, to push his fortune as a literary man. His first effort was a collection of songs entitled "The Forest Minstrel." He then tried a weekly periodical called the *Spy*. In spite of all his efforts, however, it would have fared ill with him but for the unwearied kindness and generosity of a Mr. Grieve, a worthy hat manufacturer in Edinburgh, who supported Hogg through all his difficulties and privations. At length, in 1813, the publication of the "Queen's Wake," the best of his works, established the Shepherd's reputation as a poet on a permanent and lofty basis. It was followed by "Madoc of the Moor," a poem in the Spenserian stanza; "The Pilgrims of the Sun," in blank verse; "The Poetic Mirror," a collection of pieces in imitation of some living poets; "Queen Hynde," and other poetical pieces; and also by the "Winter Evening Tales," "The Brownie of Bodsbeck," "The Confessions of a Justified Sinner," "The Three Perils of Man," and other novels of very unequal merit. The Duke of Buccleuch, in compliance with the deathbed request of his duchess in 1814, that he would be kind to the Ettrick bard, gave him a liferent of a small moorland farm at Altrive in Yarrow, where he built a cottage and went to reside in 1817. Three years later he made an advantageous marriage, and desirous once more to try his fortune as a sheep farmer, he took the large farm of Mount Benger from the Duke of Buccleuch, but was again unsuccessful. The remainder of his life, with the exception of a visit to London in 1831, and an occasional residence of a few weeks in Edinburgh, was spent in Altrive in the enjoyment of domestic happiness and social hospitality, presiding at border festivities, and spending much of his time in fishing and field sports, of which he was passionately fond. The inimitable "Noctes Ambrosianæ" kept his name constantly before the public; and though this strange miscellany of poetry, eloquence, wit, fun, and coarse humour raised a prejudice against the Shepherd in some quarters by frequently representing him in grotesque and ludicrous aspects, yet on the other hand it conveyed an expression much too exalted of his genius, sagacity, and colloquial powers. He died 21st November, 1835, leaving a widow and five children, and was buried in the churchyard of Ettrick.

The works of the Ettrick Shepherd have been collected since his death, and are comprised in eleven volumes. In grasp of intellect and depth of passion, Hogg was greatly inferior to Burns; but on the other hand, his genius was more discursive, playful, and fanciful. His masterpiece, "The Queen's Wake," is admirable, both in design and execution, and the tales and legends which it contains are worthy of a place among the lyric poetry of Scotland's greatest masters of song. "Kilmeny" is one of the finest fairy tales that ever was conceived or penned, and its scenes of supernatural splendour, purity, and happiness are altogether inimitable. Some of the Shepherd's songs and minor poems, such as "The Skylark," "When the Kye come Hame," "Donald Macdonald," "The Evening Star," &c., will last as long as the language. The best of his prose works is "The Shepherd's Calendar."

HOGMANAY', or *Hagmena*, a name given to New Year's Eve in the north of England and Lowlands of Scotland. It means "holy month" (Greek, *hagia mene*), that is, December. It is celebrated by villagers going from door to door and asking for gifts in rude rhymes of great antiquity.

"Hogmanay, trollalay,
Give cakes and cheese and let's away."

Cheese and cakes, called *farls*, and sometimes a little money, are given to the carollers.

HOGS'HEAD, an ancient measure of liquids, which, not being mentioned in the Act 5 George IV., cannot now be considered as having any legal existence, though it is still used in England and America as a measure for wine and beer, and in the latter place also as a measure for tobacco.

Formerly the hogshead of wine was 2 wine barrels, or 63 old wine gallons; the London hogshead of ale was 1½ ale barrel, or 48 ale gallons; the London hogshead of beer was 1½ beer barrel, or 54 beer gallons; and the ale and beer hogshead for the rest of England was 1½ barrel or 51 gallons. When the term hogshead is now used in England it is understood as being 54 gallons. The American hogshead contains 63 gallons when used as a measure for liquids; when used for tobacco it varies in different states from 750 to 1200 lbs.

HOHENLIN'DEN, a small village in Upper Bavaria, famous as the scene of a sanguinary battle between the French and the Austrians on the 3rd of December, 1800. The former were commanded by Moreau, and the latter by the Archduke John. The battle was fought amid drifting snow, and ended in the complete defeat of the Austrians, who had 8000 men killed and wounded, and 11,000 made prisoners, including 200 officers. They also lost 100 pieces of artillery. The French had 5000 men killed and wounded. The battle was almost immediately followed by the peace of Lunéville. It was made the subject of a fine poem by Campbell, commencing—

"On Linden when the sun was low."

HO'HENSTAUFEN EMPERORS of Germany, or more strictly of the Holy Roman Empire. See SWABIAN EMPERORS.

HOHENZOL'LERN, the name of a princely German family which traces its descent from a Count Thasilio who lived in the days of Charles the Great. The name is derived from the ancient castle of Zollern or Hohenzollern, which stands on a conical peak of the Swabian Alps, within 2 miles of Hechingen, on the road from Stuttgart to Schaffhausen. The first to assume the name of Hohenzollern or Zollern were the two counts Burchard and Wezel, who having become implicated in one of the party feuds which prevailed during the minority of the Emperor Henry IV., fell in battle in the year 1061. Count Frederick III. of Zolre, who died about 1200, was one of the most trusted counsellors of Frederick I. and Henry VI. He married the heiress of the Vohburg family, and thus obtained the title of Burggraf of Nuremberg sometime before 1176. His sons Conrad III. and Frederick IV. succeeded him, and founded respectively the Franconian and Swabian lines of the family. The former line continued to grow in influence and power during the next two centuries, but its greatest acquisition was obtained in 1415, when Frederick VI. obtained the electorate of Brandenburg in return for 400,000 gold gilders, which he had lent the Emperor Sigismund, thus founding the present reigning dynasty of Prussia. The Elector Frederick III. was the first King of Prussia, who received this rank in 1701. The Swabian line did not advance with the celerity of the other branch of the family, but during the sixteenth century it acquired considerable power and influence, and in the beginning of the seventeenth century it separated into the two families of Hohenzollern-Hechingen and Hohenzollern-Sigmaringen, the former being raised to princely rank in 1623 and the latter in 1638. This dignity was retained until 1849, when, owing to political troubles, the representatives of these two branches of the family retired into private life, handing over their principalities to the King of Prussia in return for suitable pensions. They retained their estates, and by a royal decree of 1850 were confirmed in the title of Highness. The invitation given to Prince Leopold of

Hohenzollern-Sigmaringen to become King of Spain was the ostensible cause of the war between France and Germany in 1870–71.

HOHENZOLLERN-HECHINGEN and **HOHENZOLLERN-SIGMARINGEN,** two former principalities of Germany, so called from the family referred to in the previous article. The territory is entirely inclosed between Würtemberg and Baden; its surface is mountainous, and the soil is in general stony. Corn more than enough for the consumption is raised, flax is extensively cultivated, horned cattle and sheep are numerous, and the forests abound with fine timber. There are iron mines in the northern part, but the manufactures are unimportant. The principalities were made over to Prussia in 1849. The area is 451 square miles, and the inhabitants are all Roman Catholics.

HOL'BEIN, HANS, the best of early German painters next to Albert Dürer, whom he even excelled in portraits. It is not too much to say that Holbein is the greatest portrait painter that ever lived. The magnificent portraits of Henry VIII. and Cardinal Wolsey at Christ Church, Oxford; of the members of the Barber Surgeons Company, London, or those in the National Gallery, must be admitted to prove this bold claim. Holbein was born in 1497 at Grünstadt. He was instructed in the art of painting by his father, whom he soon surpassed. Accompanying his father to Basel, Holbein painted several portraits of Erasmus, who gave him a letter of recommendation to Sir Thomas More, and he came to England in 1526. He was subsequently taken into the service of Henry VIII., and painted a large number of pictures in this country, principally portraits, for which he was munificently rewarded. Several portraits by him are in the Hampton Court Gallery. He died at London, of the plague, in 1543. Holbein was also the first wood engraver of his day. His collection of forty-one woodcuts called the "Dance of Death," exhibiting the King of Terrors advancing towards his victims unawares, in various guise suited to their guilt or merit, is considered to be the grandest example of grotesque ever given to the world (Ruskin). It was excellently reproduced in popular form by photolithography in London, 1868.

HOL'IBUT or **HAL'IBUT** (*Hippoglossus vulgaris*), the largest fish of the Pleuronectidæ (FLAT-FISH) family. It has been taken on the Scotch coast weighing 3 cwts., and usually attains a length of 5 or 6 feet. It is more elongated than the flounder or turbot, the eyes are on the right side, while the upper surface is smooth, covered with small, soft, oval scales, and of different shades of brown in colour. The under surface is perfectly smooth and white. The dorsal fin commences above the eye. It is often sold under the name of turbot, but is of inferior quality to that fish. The flesh is white and firm, but dry, and has little flavour. The fish is common on the British coasts, but more abundant in the north than in the south. It is found all along the northern coasts of Europe. It is very voracious, and devours cod, skates, and crustaceans, even attacking larger fish than itself, and biting pieces out of them. It is sold fresh, cut in slices; on the Norway coast, where large numbers are taken, the slices are salted like herrings, or after being slightly salted and rolled are hung up in the shade to dry. Large quantities of holibut are taken in the northern parts of the American Atlantic coast, and also near Greenland. It is of great value to the inhabitants of the latter country, as it not only furnishes them with a large portion of their winter food, but oil is obtained from it in considerable quantities.

HOL'IDAY, a term which, legally speaking, is restricted to Christmas Day, Good Friday, and any other day appointed by Act of Parliament to be kept as a fast or public thanksgiving. By 34 & 35 Vict. c. 17, Easter Monday, Whit Monday, the first Monday in August, and the 26th December, are made bank holidays for England and Ireland, the days for Scotland being New Year's Day, Christmas Day, Good Friday, and the first Mondays of May and August, and when Christmas Day falls on a Sunday, the following Monday is a holiday, the same rule being applied to New Year's Day. When a bill of exchange falls due on a Sunday or other holy day, it becomes payable the day before, but a bill falling due on a bank holiday is payable the day after. In public offices and law courts, in addition to Christmas Day and Good Friday, the queen's birthday, and in some instances other days, are kept as holidays. To constitute a legal holiday an Act of Parliament is necessary, and no other authority has power to declare a holiday which can bind the public or affect the rights of third parties.

HOL'INSHED, RAPHAEL, was born probably during the first half of the sixteenth century. Anthony à Wood says that he "was educated at one of the universities, and was a minister of God's word." It appears most probable that he was chaplain or steward to Thomas Burdet of Bromcote in Warwickshire. He died about 1600.

Holinshed is important in English literature, not so much for his work, which though excellent is mere compilation, as for the fact that Shakspeare derived from this author his knowledge of English history. Holinshed's first edition was published in 1577, when the poet was a youth of thirteen. This first edition is a very scarce black-letter in two vols. folio, adorned by numerous woodcuts. The second edition omits these adornments, and has suffered also from the censorship of the times, which compelled the cancelling of several sheets. It consists of the following items:—"Description of England," by Harrison; of "Ireland," by Stanihurst; and of "Scotland," from the Latin of Hector Boethius, by W. H(arrison); "History of England," by R. H(olinshed); of "Ireland till the Conquest," from Giraldus Cambrensis, by J. Hooker (an uncle of the divine); "till 1509," by Holinshed; and "till 1586," by Hooker and Stanihurst; and of "Scotland till 1571," by Holinshed, and continued by others.

HOL'LAND, the name (which is derived from *Holt-land*, meaning wood-land) generally given to the kingdom of the NETHERLANDS, but properly applicable only to the two provinces described in the next article.

HOL'LAND (NORTH and SOUTH), two contiguous provinces, and the most important in the kingdom of the NETHERLANDS, situated between 51° 45′ and 53° 30′ N. lat., and 3° 45′ and 5° 20′ E. lon., is bounded N. and W. by the German Ocean, E. by the Zuider Zee and the provinces of Utrecht and Gelderland, and S. by Zeeland and North Brabant. The surface is flat, and in many parts below the level of the sea, against which it is protected by the sandy downs on the west coast, and by stupendous dykes built along the shores of the Zuider Zee, the Haarlem Meer, and the banks of the principal rivers. The country is traversed by canals in all directions. A railway from Rotterdam through the Hague, Leyden, Haarlem, Amsterdam, Utrecht, and thence to Rotterdam, incloses a very important part of the province. The soil is marshy, but has some rich pastures, which support a fine breed of horses, cattle, and sheep. Gardens and orchards are carefully cultivated; barley, oats, pease, beans, mustard, and other seeds are the chief crops in the northern part of the province; in the southern part more corn is produced. But pasturage prevails much more than arable cultivation, the produce of the dairy farms, butter and cheese, constituting the chief wealth of the landholder. A remarkable feature of the country is the *polders*, a name given to lands that are below the level of the sea or adjacent river, and, having once formed a lake or marsh, have been surrounded by dykes and cleared of water by means of pumps worked by windmills. The lands thus reclaimed are very fertile, and some of them of great extent, as the Beemster polders, near Edam, in the northern part of the

province, which are 16 miles in circumference; the grain sown in them is sometimes destroyed by water, but this is rare, for the mills are always at work, when there is any wind, lifting up the water to such a height as gives it a fall into the nearest river, canal, or sea. The effect produced on foreigners who visit the polders for the first time is one of surprise, not unmingled with alarm, at the apparent inversion of the natural order of things; luxuriant corn and rich grass crops growing, and fat cattle and sheep pasturing, where water should lie; while the large sails of the canal barges flit past high above dykes, houses, and trees. The draining of the Haarlem Meer, or lake, by steam power by an English company reclaimed more than 40,000 acres of land, which are now divided into farms under pasturage or tillage. Flowers are cultivated in the tract between Alkmaar and the Hague, but especially about Haarlem. Hemp, flax, and madder are grown. Wood, both for construction and for fuel, is scarce. The manufactures, which are chiefly carried on in the towns, are important. They consist of linen, paper, woollen cloths (for which Leyden is famous), silk, leather, tobacco, sugar, &c. The gin distilleries of Schiedam are very extensive, and have been long celebrated. Large quantities of fine lime are made from the shells gathered on the coast of the German Ocean. The fisheries on the coasts are important, and most industriously prosecuted. The sleekness of the cows and horses, and the cleanliness of the dairies in Holland are proverbial. The horses are all tender in the hoof.

To the lover of the mountainous the aspect of Holland is tame and uninteresting. The country is one vast plain, diversified neither by mountain, hill, nor knoll. Viewed from the top of a tower or spire, it appears like an extensive marsh intersected by numberless ditches and canals. Yet the monotony of this prospect is relieved by some features of great interest, meadows of wide extent and of the most beautiful verdure covered with large herds of well-fed cattle, sheets of water, with all the varied interests of boat-life, clusters of trees, and in the vicinity of large towns elegant villas and parks decorated with statues and busts.

North Holland extends north of the Haarlem Meer and the mouth of the old Rhine. It has an area of 1070 square miles, and a population in 1883 of 732,692. The Amstel and the Vecht flow through the south-east of the province, the Zaan through its centre. The Helder Canal, by which the largest merchant vessels reach Amsterdam direct from the German Ocean without encountering the difficult navigation of the Zuider Zee, runs from Amsterdam to the Mars Diep or strait that separates the Texel from the mainland. It is 120 feet wide, 25 deep, and above 50 miles in length. The chief towns are Amsterdam, Alkmaar, and Haarlem.

South Holland has an area of 1166 square miles, and had 851,895 inhabitants in 1883. It lies south of the Haarlem Meer, and is traversed by the Old Rhine, the Yssel, the Lech, and by the large branches of the Maas, which form the islands of Voorne, Overflakee, Goeree, Putten, Beveland, Ysselmonde, Dordrecht, and Rozenburg, west of Ysselmonde. The chief towns are Delft, Dort, the Hague, Leyden, and Rotterdam.

HOLLAND, SIR HENRY, a distinguished London physician, was born at Knutsford, Cheshire, 27th October, 1787, of a respectable family, and received his principal education at a Bristol school. Leaving a merchant's counting-house at Liverpool, in which he had been placed for a short time, Mr. Holland commenced the study of medicine in Edinburgh, where he graduated in 1811. In the next three years he travelled in the countries bordering on the Mediterranean, and in 1815 published his "Travels in Portugal, Sicily, the Ionian Islands, and Greece." In 1814 he was appointed domestic medical attendant on Caroline, princess of Wales (afterwards queen), and was thus introduced into that exalted circle in which he attained a well-deserved popularity until his death at the ripe age of eighty-six, on the 27th October, 1873. Sir Henry Holland—he received his baronetcy in 1853—was better known as the genial and sagacious family physician, than for eminence in any special line of pathology. He made the frank admission that "the practice of a West-end physician abounds in cases which give little occasion for thought or solicitude, and are best relieved by a *frequent* half-hour of genial conversation." Sir Henry took regular annual tours, and in this way he crossed the Atlantic sixteen or seventeen times, travelled over 26,000 miles of the American continent, made four expeditions to the East, three tours in Russia, two in Iceland, several in Sweden, Norway, Spain, Portugal, Italy, and Greece, besides voyages to the Canary Isles, the West Indies, Madeira, &c. His intimate association throughout the same period with distinguished public men of all ranks and professions in Great Britain and Europe lends a special charm to his "Recollections of Past Life," published in London in 1872.

HOLLAND, LORD (Henry Richard Vassal Fox), was the only son of Stephen, second Lord Holland. His mother was Mary, daughter of John Fitzpatrick, first earl of Upper Ossory. He was born at Winterslow House, Wilts, 21st November, 1773. He succeeded to the peerage when he was little more than a twelvemonth old. He was educated at Eton and at Christ Church, Oxford, where he took the honorary degree of M.A., in right of his rank, in June, 1792.

It was in the course of a continental tour that at Florence, in the beginning of the year 1795, he first met Lady Webster, the wife of Sir Godfrey Webster, with whom he returned to England in June, 1796, and whom he married the next year, after she had been divorced from her first husband, who obtained £6000 damages in an action against Lord Holland. After his marriage with Lady Webster, Lord Holland assumed, by sign-manual, her family name of Vassal, which, however, has been laid aside by his children. He now took his place in the House of Lords, and his first speech was made on the 9th of January, 1798. From this date he took a frequent part in the debates for the next four years, being all this time a steady opponent of the administration.

On 28th August, 1806, Lord Holland and Lord Auckland were appointed joint-commissioners for arranging the several matters in discussion between this country and the United States, with Mr. Munro and Mr. Pinckney, the United States' commissioners; and on the 27th of the same month he was sworn of the Privy Council. An arrangement of the differences with America was effected after a long negotiation, but Mr. Jefferson refused his ratification, and it came to nothing. On 15th October, after the death of Mr. Fox, Lord Holland was appointed lord privy seal; and he held that office for the six months longer that the Grenville ministry lasted.

In 1806 Lord Holland published "Some Account of the Life and Writings of Lope Felix de Vega Carpio," and followed it up next year with "Three Comedies from the Spanish," and in 1808 he edited and introduced by a preface Mr. Fox's fragment entitled "A History of the early part of the Reign of James II." In the long period during which his party was banished from power he was known as the zealous defender of all oppressed races and persecuted sects. The movements for the extension of the suffrage, Catholic emancipation, the repeal of the corn laws, and the abolition of the slave trade, all received his hearty support, and differing from his party in his estimate of Napoleon he protested against his detention at the island of St. Helena.

On the accession of the Whigs to power in November, 1830, he became once more a cabinet minister as chancellor of the duchy of Lancaster; and this office he held (with the

exception of the ministerial interregnum of a fortnight in May, 1832, and Sir Robert Peel's four months' tenure of power, from December, 1834, to April, 1835) till his death at Holland House on the 22nd of October, 1840.

HOLLOW WARE is the name given to articles made of iron and used chiefly for cooking and other domestic uses. There are two kinds, cast and wrought. The latter is often made by stamping a piece of iron to the shape required by means of powerful machinery; but the dearer kinds are still made by the old process of joining different pieces together. The articles not intended to be used for cooking are generally covered with zinc, and the others with tin or a silicious enamel [see ENAMEL]; and since their introduction the latter have, to a great extent, superseded the old copper and brass kitchen utensils. Most of the English hollow ware is made in the district of which Birmingham and Wolverhampton are the centres.

HOL'LY (*Ilex Aquifolium*) is a species of the same genus, ILEX, as the South American Paraguay tea or maté and the North American black alder and inkberry; there are also species found in India and Japan. The common holly, which constitutes so beautiful a feature in the winter scenery of many parts of England, and whose scarlet or yellow berries render it so universal a decoration of churches and dwelling-houses at Christmas time, is in Great Britain upon the most northern limits within which it ranges in a wild state. It is however, at those limits that it attains its greatest size and beauty; but it occasionally suffers from severe winters. It is common in the middle of Europe, extending from 62° N. lat. in Norway to Turkey in the south, and eastwards to the Caucasus and Western Asia. The Old English word for the tree was *holen* or *holegn*, whence in later times *holm* and *holly* were derived. It is chiefly valued as a shelter in winter and an ornamental tree. Hedges formed of it are impassable. Evelyn had a famous hedge which he planted himself in his garden at Sayes Court; it was 400 feet in length, 9 feet high, and 5 feet in diameter. The wood is fine-grained, heavy, and compact, and is used for a great number of useful purposes, especially by the turner and mathematical instrument maker. Birdlime is manufactured from the inner green layers of the bark, separated by boiling, and fermented. The leaves and bark were formerly used as a febrifuge, and the root and bark as diuretics and expectorants. The berries of the holly produce purgative and violent emetic effects in man, but are eaten by birds.

There are a great number of varieties, with white, yellow, and black berries, leaves with yellow or white margin, or spotted, &c. The variety Ferox has the leaves covered all over with sharp prickles.

Holly, as a Christmas decoration, is a relic of the ancient saturnalia. This season of jollity was adopted, as were so many pagan customs, by the early church, and the holly which used to decorate the temples, and which was sent from one person to another as a memento of good fellowship at this time, now served the churches and their converts for like uses. There is also a tradition, firmly held throughout the middle ages, that the burning bush in which the Lord appeared to Moses was a holly-tree. For Sea-holly and Knee-holly see ERYNGIUM and RUSCUS.

HOL'LYHOCK (*Althæa rosea*) is a hardy biennial plant, nearly allied to the marsh-mallow, and belonging to the order MALVACEÆ. The stem is tall and straight, from 8 to 15 feet high. The leaves are heart-shaped, with five to seven angles, lessening into bracts in the flowery part of the stem. The large showy flowers spring from the axils of the leaves, forming a spike in the upper part of the stem. It is a native of the Levant, and was introduced in 1573. It is extensively cultivated in India. Numerous varieties have since been raised, with single and double flowers. Hollyhocks may be propagated by sowing the seed in the open border and transplanting, or by division of the root, or by planting in a close frame eyes from the shoots.

HOLMFRITH, a village of England in the county of York, in a beautiful valley, 6 miles south by west from Huddersfield, and 187 miles from London by rail. It is well built, and has a handsome town-hall, parish church, and a mechanics' institute. The manufactures are plain and fancy woollens. In 1852, by the bursting of a reservoir which furnished water-power to the various factories many lives were lost here, and much property destroyed.

HOL'OCAUST (Gr. *holos*, the whole; and *kaustos*, burnt), among the classical ancients, a religious sacrifice in which the whole instead of a portion of the victim was burned as an offering to the gods. The custom was not dissimilar to the whole burnt-offering of the ancient Jews, which consisted of a bullock without blemish brought to the tabernacle of the congregation.

HOLOCEPH'ALI forms one of the primary divisions of the class FISHES (Pisces), being regarded either as an order or subclass. This group contains only one family, Chimæridæ, and two genera, Chimæra and Callorhynchus. The Holocephali agree with the sharks (CHONDROPTERYGII) in many respects, especially in external appearance and in the structure of their reproductive organs. The intestine has a spiral valve. The heart has a *conus arteriosus*. In the structure of the skull the Holocephali present remarkable differences from other fishes. The upper jaw is not separate, but is fused with the cranium. There is no separate suspensorium for the lower jaw, hence the skull is termed *autostylic*. The notochord is persistent, runs throughout the body, and is unsegmented. There is only one external gill-opening; a soft membranous opercular fold protects the four gill slits. *Chimæra monstrosa*, the king of the herrings, ranges round the coasts of Europe, extending tolerably far north; it is also found on Japanese coasts and at the Cape of Good Hope. It feeds on crabs and molluscs, herrings and other fishes. The first dorsal fin is placed near the head and provided with a very strong and long spine; close behind it rises the second dorsal, which extends throughout the back. The tail is long and tapering, provided with a small fin above and below. The pectorals are large. This species is about 3 feet in length, brown in colour, with light spots. Two other species are known, *Chimæra colliei*, from the west coast of North America, and *Chimæra affinis*, from the coast of Portugal. Of the second genus, Callorhynchus, only one species exists, *Callorhynchus antarcticus*, common in the Southern Pacific and at the Cape of Good Hope. The snout of this fish has a cartilaginous prominence, terminating in a flap of skin. The extremity of the tail is distinctly turned upwards, and lacks the fin along its upper surface found in the Chimæras. The anal fin is well developed.

HOL'OGRAPH, a deed or testament written wholly by the testator's own hand. By the law of England it does not matter whose penmanship is used in the making of a will or deed, provided the document be properly signed and attested. In Scotland the same general rule applies, but holograph documents differ from deeds duly attested in some important respects. Such documents are valid without witnesses, but they do not prove the dates which they bear, and in the absence of extrinsic evidence will be presumed to be of a date least favourable for their purpose. An exception to this has, however, been introduced in the case of wills by 37 & 38 Vict. c. 94, s. 40, which provides that these documents shall be deemed to have been executed of the dates they bear, unless the contrary is proved. Holograph writings prescribe if not sued on within twenty years, unless the plaintiff proves by the oath of the defendant that they are genuine.

HOLOHE'DRAL FORMS are those which have all the faces present that can coexist. In any system they are those forms which have the most complete development, and in which modifications or developments of secondary faces take place in all similar parts. In compound forms holohedral forms always combine with holohedral.

HOLOPTY'CHIUS (Gr. *holos*, whole; and *ptyx*, a wrinkle) is a genus of fossil fishes belonging to the order GANOIDEI, so named from the wrinkle-like markings on the large enamelled scales. They were large fishes confined to the Devonian rocks. There were two dorsal fins placed very far back. The pectoral fins were narrow and acutely lobate. The head was small; but the unclothed jaws, covered with hard enamel instead of skin, were lined with a double row of teeth—the outer range thickly set, and fringing the enamelled edge of the mouth; the inner ones wider apart, fang-like, and more than twenty times as large. The species figured, *Holoptychius nobilissimus*,

Holoptychius nobilissimus.

is nearly perfect, but the tail is wanting. Without the latter appendage the specimen measures 30 inches in length, and the proportions are remarkably massive.

HOLOSID'ERITES are those meteorites that are entirly composed of metallic matter, which in most instances is meteoric iron (an alloy of iron and nickel). Minerals that do not occur on the earth have been found in some of them, as Troilite (FeS), Schreibersite, a phosphide of iron and nickel containing magnesium, and Daubrèeite (FeS, Cr_2S_3).

HOLOTHUROI'DEA is a class of the subkingdom ECHINODERMATA, of which the animals known as sea-cucumbers or trepangs are examples. The body is cylindrical or worm-like, inclosed in a tough leathery skin, in which are scattered grains of calcareous matter, often arranged in a regular pattern. The body is very extensile and contractile. At the anterior end of the body is situated the mouth, which is surrounded by a fringe of tentacles, from ten to twenty in number, generally more or less feather-like. These tentacles are prolongations of the water-vascular system, and subserve respiration. Being retractile, they serve as organs of touch and prehension, and sometimes of locomotion. The alimentary canal is simple and much coiled, terminating in a large cloaca at the opposite extremity to the mouth. Two branched processes of the cloaca are generally present, the respiratory trees or lungs; the animal can receive or expel water by means of this apparatus, which possibly thus assists it in its locomotion, as well as supplies air from the inhaled water. These animals are, like leeches, exceedingly sensitive, and when disturbed will sometimes contract so violently that the integuments are ruptured and the intestines protrude. These violent contractions are due to the powerful muscles with which the skin is lined. There is a blood-vascular system, the principal vessels of which are two trunks, one on the dorsal and the other on the ventral side of the alimentary canal. The reproductive organs are situated near the mouth, and the sexes are distinct, except in Synaptidæ. Reproduction is sometimes direct; the amount of metamorphosis which the larva undergoes is never so considerable as in other classes. Most Holothuroidea creep by means of their tube feet; in others locomotion is effected by the extension and contraction of their bodies and by the tentacles; some of the Synaptidæ are able to swim. The Holothuroidea live among sand, seaweed, &c.; they live on diatoms and other minute creatures of the sea as well as on the nutritious matter they extract from the sand or coral which they swallow. The Holothuroidea are generally distributed throughout the seas of the globe, but are congregated in the greatest numbers in the Eastern seas. Those of the European seas are never highly coloured, but in more tropical seas, where coral reefs rise within a moderate distance of the surface, as in the Red Sea and the seas to the north and east of Australia, there are many of them splendidly coloured. The general form of these animals is that of a cucumber, and many of the species are of a gelatinous nature and esculent.

The Holothuroidea are divided into two orders. In the first order, Apneumona, there are no special respiratory organs, and the sexes are united in one individual; it contains only two families, Synaptidæ, in which the tube-feet are absent, and Oncinolabidæ. The second order, Pneumonophora, contains the typical SEA-CUCUMBERS (Holothuria), forming the family Holothuriidæ, and also the following families—Molpadiidæ, without tube-feet, and, as far as is known, hermaphrodite; Psolidæ, and Rhopalodinidæ, having four respiratory trees.

HOL'STEIN. See SCHLESWIG AND HOLSTEIN.

HOLY ALLIANCE, a league formed among certain of the principal sovereigns of Europe after the defeat of Napoleon at Waterloo, on the proposal, it is said, of the Emperor Alexander of Russia. It arose from the religious feeling then prevalent of deliverance from French domination, which was considered as a consequence of the French Revolution, and Napoleon as an incarnation of evil; and one of its declarations was that no member of the family of Napoleon was ever to occupy a European throne. The Act consisted of a declaration that, in accordance with the precepts of the gospel, the principles of justice, charity, and peace should be the basis of their internal administration and of their international relations, and that the happiness and religious welfare of their subjects should be their great object. Most of the European sovereigns became members of the Alliance, and the treaty was formally published in the *Frankfurt Journal* of 2nd February, 1816. It soon became evident, however, that the pious language of the treaty was merely a hypocritical mask covering a conspiracy, on the part of the despotic monarchs by which it had been drawn up, against the liberal spirit then breaking out all over the Continent. It was by virtue of this league that the liberal constitution of Naples was crushed by Austria in 1821, and that absolutism was restored in Spain by France in 1823. A disposition to extend its influence to South America, where the Spanish colonies were throwing off the yoke of the old country, led to the publication of the Monroe doctrine of the United States, which declared that any attempt to coerce the South American republics would be regarded by the States as an unfriendly act. The secession of England and France from the Alliance left it without cohesion or authority, and after the death of the Emperor Alexander it ceased to have any active existence.

HOLY CITIES. Most religious faiths have one city round which holy memories cluster, and to which their adherents love to make pilgrimages. For the Jews and ourselves the holy city is of course Jerusalem; for the

Russians Moscow, and almost in the same degree Kiev; Mecca for the Mohammedans, and in a less degree Medina; Allahabad for the Mohammedans of India; Benares for the native Hindus. Japan has its sacred Shin-to city of Kioto. Pizarro plundered the ancient holy city of the Incas of Peru, Cuzco, built, as they said, by Manco, the child of the sun, the first Inca, and named "navel" (*cuzco*) as being the centre of the universe for them. Here was the great golden sun-face, the reflection from which illuminated the temple when the sunlight played upon it, and was caught in its turn by countless plates and images of gold.

HOLY FIRE is a fire kindled on Holy Saturday morning (the day after Good Friday), in the Roman Catholic Church, from sparks struck from a flint. In the early ages of the church it was the custom before vespers to procure a light in this way, from which the lamps and candles in the church were lighted and kept up till vespers on the following day. In the ninth century, under Pope Leo IV., this custom of obtaining new fire from a flint was extended to Holy Saturday, on which day vespers are not recited. The ceremony, as it now takes place, represents Christ as the "light" rising from his "stone"-protected sepulchre. The Paschal Candle, and the candles placed on the altar, are lighted from the fire thus obtained, while the words *Lumen Christi* (Light of Christ) are thrice repeated. The lamps in the church are previously extinguished, so that it is from this "blessed" fire that they, together with all other lights in the church, are rekindled.

HOLY GHOST, ORDER OF THE. The order *du Saint Esprit* was one of the great knightly orders of chivalry. There were two older orders bearing this name, one Neapolitan, instituted by Louis of Anjou, king of Naples, in 1352; and one French, instituted by Count Guy of Montpellier about 1198, and merged into the order of St. Lazarus in 1672, re-established in 1708, and reunited with St. Lazarus in 1760.

But the order which is usually meant when this title is used is the great French royal order, established by Henry III. of France in 1578, and lasting until the outbreak of the French Revolution in 1789. It was re-established on the restoration of the Bourbons in 1815, and perished with their fall in 1830. It was for royal France in a less degree what the Garter still is to England.

HOLY ISLAND or **LINDISFARNE,** an island in the North Sea, off the N.E. coast of England, opposite the mouth of the Lindis rivulet, 10 miles S.S.E. of Berwick, and separated from the mainland by a narrow belt of sand passable at low water, is about 3 miles long and 1½ mile broad, and consists almost entirely of sandhills 60 feet high. A small portion in the south forms a plain fit for tillage. At its south-east extremity is a perpendicular cliff crowned by an old castle; but the chief object of interest is the old abbey of Lindisfarne, of which large portions, indicative of its original magnificence, still remain. It was founded by Aidan, a monk of Iona, in 636, and was long a celebrated seat of learning and the centre of missionary work among the heathen English of the Northumbrian kingdom by preachers from the Primitive Irish Church and disciples of Columba at Iona. It is beautifully described in the second canto of "Marmion":—

> "In Saxon strength that abbey frown'd,
> With massive arches broad and round,
> That rose alternate, row and row,
> On ponderous pillars short and low,
> Built ere the art was known,
> By pointed aisle and shafted stalk,
> The arcades of an alley'd walk
> To emulate in stone."

Holy island is composed of sandstone and limestone, with beds of coal and ironstone. The inhabitants number 550, and are mostly fishermen. The island was at one time the seat of a bishopric, which was removed to Chester-le-Street in 875, and thence in 995 to DURHAM.

HOLY LAND. See PALESTINE.

HOLY LEAGUE, THE (1510), was the outcome of the League of Cambrai (1508). Louis XII. of France had arranged the latter from hatred to Venice; the Emperor Maximilian, Pope Julius II., and the King of Aragon were his allies, and Louis carried off the victory of Agnadel against the republic. Julius II., alarmed at the sudden growth of the French power in Italy, and having gained the few places in the Romagna which he desired, and which, together with a desire to humble Venice, formed his real motives for entering into the League of Cambrai, was now as eager to conspire against the King of France as formerly he had been willing to join with him. He therefore approached the Venetians in their crippled condition, and joined by them, the Swiss republic, and the King of Aragon, Ferdinand the Catholic, he declared the Holy League to drive the French from Italy. Louis XII. met with reverse after reverse (England joined the allies and helped with the defeat at Guinegaste, the "battle of the spurs"), and was glad to sign peace in 1514. For the great Catholic League (1576) of the French religious civil wars under Henry III. and Henry IV., sometimes called also "Holy League," see LEAGUE, THE.

HOLY MAID OF KENT. See BARTON, ELIZABETH.

HOLY ORDERS. See ORDINATION.

HOLY ROMAN EMPIRE. This is the true title of the great mediæval form of government which is now almost universally called the *German Empire*, or simply the *Empire*, and the sovereigns of which, though by right emperors of Rome, are always called, as in fact they were, emperors of Germany.

The nominally unbroken succession of the Roman Empire from shortly before the Christian era down to 1806 is so remarkable as to call for a brief account. The ancient Empire of Rome, which began with Julius Cæsar, had so extended its boundaries eastward that at the close of the third century of our era Rome herself lay inconveniently to the west. Diocletian, at Nicomedia, was the first emperor permanently to govern elsewhere than from Rome. Constantine the Great, soon after he had attained supreme power, in A.D. 323, chose Byzantion (Byzantium), an ancient Greek city on the Bosphorus, as the seat of empire, and renamed it New Rome. But as it was he who gave it its splendour, it received the name of Constantine's city—Constantinopolis, and this name speedily drove the other out of men's minds. The fashionable language spoken by the nobles and used by authors in the Roman Empire had been for some time Greek (though the official state language for laws, &c., long remained Latin), and this Greek language and civilization, as replacing the Latin and Roman ways, grew into a still more fixed rule after the removal of the seat of empire, so that the empire after Constantine is called very fairly the GREEK EMPIRE (as in the article in the present work); or it is called otherwise the Eastern Empire as contrasted with the Western Empire, when presently there came to be one; or it is called the Byzantine Empire. But it always called itself the *Roman Empire*, and its people called themselves (though they spoke in Greek) *Romans*.

At the death of Theodosius, in 395, his sons divided the empire. Arcadius was sovereign of the Eastern, Honorius at Ravenna ruled the Western Empire. But this last was so feeble as to be quite unable to cope with the barbarians, and even by 410 Rome had been sacked by Alaric, while by 476 the Western Empire came to an end, and the barbarian king Odoacer ruled the land—not, however, as king or emperor of Rome: he was king of his own tribe, the Heruli; his control of Italy was as *patrician* or viceroy of the Eastern Emperor Zeno. The miserable Roman Senate passed a decree that the empire should again be one—of course a pure form. Odoacer was succeeded (still

under the title of *patrician*) in 493 by Theodoric, king of the Visigoths (West Goths), and after Theodoric's time the Eastern emperors were able to appoint their own patricians.

Meanwhile Italy was growing into some feeble semblance of a state, greatly through the waxing influence of the Bishop of Rome. Soon these bishops, calling themselves popes, were strong enough to wage ecclesiastical war against the emperor and the Eastern pope or patriarch, who were for abolishing the worship or reverence of images in the church. So fierce did this strife grow over ICONOCLASM that it cost the emperors their last real hold over Rome [see also GREGORY II. and III.], though for some time to come they held possessions in Southern Italy. The Lombards had won Northern Italy, and by the middle of the eighth century they threatened Rome. The pope and the people, looking now no longer to Constantinople for help, turned towards the great Frank power which had arisen in the West under the Karling mayors of the palace, ruling in the name of the Merwing Frankish kings. Pippin, the last of these mayors, got Pope Zacharias to decree that being king *de facto* he was at liberty to assume the kingly title, which he therefore did in 751, and in 752 St. Boniface crowned him. The grateful Frank made, or was said to have made, the famous DONATION of territory on which the popes founded, later on, their temporal sovereignty. This was the pope's share of the large Italian conquests of Pippin from the Lombards. The pope conferred upon Pippin the title of Patrician of the Romans, and he held all Italy save the south and the papal Donation. As the rule of the Franks waxed, that of the (Greek) "Roman" emperors waned. In 792 the young Emperor Constantine VI. was deposed by his mother Irene, who had the barbarity to put out his eyes in addition. Now apart from the irregularity of the succession, no woman had ever nominally been empress, though many had wielded the sceptre in their husband's or their son's name. The Italian people therefore seized the opportunity, and elected Karl (Karl the Great or Charlemagne), the son and successor of Pippin, emperor of Rome. In the year 800, Karl, already king of the Franks, king of Lombardy, and patrician of the Romans, was crowned by the pope, Leo III., in St. Peter's on Christmas Day under the title of Carolus Augustus, *Emperor of the Romans*, and was held by the greater part of Europe as the actual and true successor of Julius Cæsar, though his capital was neither Rome nor Constantinople, but Aix-la-Chapelle. In studying mediæval history this sequence, which has been here at some length set forth, is but too often forgotten. It cannot be too firmly pronounced, however, that in the eyes of all men but the Byzantine emperors and their restricted empire, the new Empire of the West was the true Empire of Rome. Yet as the other state continued to challenge the title, and as the religious divergences were very great and growing greater, the popes, who claimed the right of crowning the emperors of Rome, called the latter Western Empire the *Holy* Roman Empire, to distinguish it from the empire of Constantinople. The extreme South of Italy did not belong to the "Holy Roman" Empire, but to the (Greek) "Roman" Empire for two centuries more.

The sovereigns of the Holy Roman Empire were kings of the Franks, speaking German, though the language of the state, the law, and the church was Latin. But though the kings of the Franks and their successors, the kings of Germany, were *de facto* possessed of the imperial power, they were never called emperors until their coronation by the pope. Therefore, as is elsewhere shown in detail, several sovereigns whom we rank among the emperors were never possessed of that title. [See GERMANY, section *History*.] Henry, the son of the great Barbarossa (Frederick I.), who became in due time Henry VI. (in 1190 A.D.), was the first to call himself King of the Romans as heir to the empire, in the same sense as the heirs-apparent in England are called princes of Wales. Frederick III. was the last emperor crowned in Rome; his successor Maximilian I. took the title of "emperor-elect" without coronation by the consent of the pope. Charles V. was crowned emperor by the pope at Bologna (not Rome) in 1530, but after him no emperor received papal sanction till the French emperor, Napoleon I. Very soon, that is, at the close of the sixteenth century, the kings of Germany and emperors of Rome called themselves *Emperor of Germany* and *King of the Romans*, and it was not long before both the one title and the other was little more than a badge of honour worn by the princes of Austria of the house of Hapsburg. Thus altered from a Holy Roman Empire into a German Empire, the ancient title lingered on till 1806, when Francis II. quietly altered his style to Emperor of Austria, upon the Emperor Napoleon being acknowledged head of the Confederation of the Rhine (that is, of Northern Germany).

The Holy Roman Empire inherited two fatal names; both the connection with the popes and the connection with Rome led to disaster upon disaster. The one brought about the cruel strife between pope and emperor under the emperor Henry III., when the empire crushed the church, and under the emperors Henry IV. and V., and later on under the brilliant Frederick II., when the church got the better of the empire. Hence arose the bitter conflict between GUELFS (Papalists) and GHIBELLINES (Imperialists), elsewhere described. In one sense also it was Charles V.'s position as emperor which converted the Reformation into a Protestant movement instead of allowing it to remain a Catholic reformation as at first, for it is quite clear that Charles's aims were dynastic, not religious. He withstood Luther more because he was bound to support Rome, as his predecessors in the empire had done, than because he disagreed with all that he put forward. The result was the Thirty Years' War instead of some peaceful arrangement, or if no arrangement had proved possible, a dignified secession, leaving only such wounds as time would heal. The other connection led to the frequent absence of the German king from his own proper dominions to assert and maintain his supremacy over the half-independent states of Italy. Barbarossa, Frederick II., Henry VII. (Dante's *beau ideal*), all lost their lives and wasted their reigns in consequence of their connection with Italy, and the evil influence was felt by other princes in a greater or less degree. Hence too arose the fatal rivalry between France and Germany for Italian influence, which led to the fearful loss of blood under Charles VIII., Louis XII., and Francis I. of France. And worst of all, hence arose that crushing down of the liberties of Italy for centuries under the Austrian and Spanish tyrannies until her happy release under Victor Emmanuel, and her rise into a flourishing kingdom of Italy in our own day.

HOLY WATER is water which has been mingled with salt, and specially exorcised and blessed by a bishop or priest for certain religious uses. The use of holy water in the Christian church is generally traced to the observances of the ancient Jewish ritual, in which the hands and face were sprinkled with water before entering the sanctuary, though many scholars regard the practice as being of pagan origin. Certainly the use of consecrated water for sprinkling those who entered the temple was common among the ancient Greeks, as was also the practice of mingling salt with water for sacramental purposes. In the Roman Catholic Church a somewhat elaborate ceremonial is enjoined upon the priest for the consecration of holy water, and it is used in connection with the regular worship of the church, in the consecration of sacred objects, and at marriages and funerals. A vessel of holy water is kept at every church door, and it is used by the worshippers on entering and leaving for making the sign of the cross.

By educated Roman Catholics the efficacy of holy water is attributed to the prayers of the church, which solemnly blesses it, and its use is also regarded as valuable from its symbolic suggestions of purity and consecration. From the writings of the fathers it appears that the use of holy water was condemned by many as savouring of heathenism during the early days of the church; but the custom ultimately prevailed over all opposition, and was generally prevalent by the eighth and ninth centuries. It is now used by the Roman Catholic, Greek, Russian, and Oriental churches, but is rejected by the Protestant churches as being unscriptural.

HOLY WEEK, called also *Passion Week*, is the week before Easter, commencing on Palm Sunday, and comprising Holy Thursday, Good Friday, and Holy Saturday. It is commemorative of the Passion of Christ during the week previous to his resurrection. Many Protestants observe only the Friday [see GOOD FRIDAY] as a solemn day; but in the Roman Catholic Church the whole week is made one of great solemnity and fasting. They, however, call this Holy Week, and the preceding one Passion Week. Holy Week has never been observed by Presbyterians.

HOL'YHEAD ISLAND, a small island of North Wales, on the western side of Anglesey, from which it is separated by a sandy strait, fordable at low water. Its greatest length is 7 miles, and its breadth 3½. The area is 7000 acres, and the population in 1881 was 8680. The island has some good pasture and arable land, but is mostly rocky and barren; the northern coast especially being very wild, and marked with precipices and caverns haunted by innumerable sea-fowl, while the falcon eagle soars over the highest crags. On the north-west coast are two islets, named respectively North and South Stack, on which there are lighthouses, with revolving lights visible 20 miles distant. South Stack is connected with Holyhead island by a suspension bridge.

HOLYHEAD, a seaport and market-town, is situated on the island of Holyhead, and is 264 miles north-west of London, with which it is in direct communication by railway. It is the government steam-packet station for Dublin, from which it is distant about 70 miles, and on this account the attention of government was specially directed many years ago to the providing of improved harbour accommodation here. The coast around is very dangerous, and it appeared highly desirable to provide also a secure harbour of refuge. This has been accomplished by the construction of a massive breakwater, 7860 feet in length, inclosing a harbour 267 acres in extent, and (in addition) a roadstead of 400 acres of deep water. The solid masonry wall of the breakwater is erected on a rubble mound of stone of great size, the water being here from 40 feet to 55 feet deep. At the level of low water the mound is nowhere less than 250 feet in width, and in 50 feet depth it is 400 feet wide at the base. It contains altogether about 7,000 000 tons of stone. The solid wall crowning the mound is carried up to 38 feet 9 inches above low water, and a spacious promenade is surmounted on the sea side by a handsome parapet. At a lower level, or at 27 feet above low water, there is on the harbour side a terrace or quay 40 feet wide. At the end of the pier is an oval structure of enormous strength, 150 feet long and 50 feet wide, the solid masonry being carried down into the rubble mound to more than 25 feet below low water. On this, the head of the pier, stands a lighthouse. Rather more than twenty-five years were occupied in the construction of the breakwater, which, commenced in 1847, was opened by the Prince of Wales on 19th August, 1873. The cost of the harbour thus formed was great, amounting to £1,500,000; but considering the immense protection afforded to life and property, it is certainly money well laid out, especially when it is remembered that nearly 4000 ships seek refuge within it during the year. During the past few years the face of the country contiguous to and bordering on Holyhead harbour has undergone great change, chiefly owing to the enterprise of the London and North-western Railway Company in providing for the constantly increasing traffic between their packet stations at Holyhead, Dublin, and Kingston. In 1873 the company obtained an Act for the enlargement of the old harbour, and the works were opened by the Prince of Wales in 1880. The water area of the old harbour was increased from 10 to 24 acres, with a uniform depth of 13 feet at ebb and 30 feet at flood spring tides, and 18 feet and 23 feet respectively at neaps. The length of quay accommodation is over 4000 feet, and there are 15 miles of sidings. A graving dock has also been constructed. Holyhead is called by the Welsh *Caer Gybi*.

HOL'YROOD, on the eastern side of Edinburgh, was anciently the residence of the Scottish sovereigns and the scene of many tragical events connected with their history. Its site is a small plain or valley between the Calton Hill and the majestic Arthur's Seat. It was an abbey founded by King David I. of Scotland in 1128, and dedicated in honour of the Holy Cross or Rood brought from Jerusalem by St. Margaret in 1070, which became one of the heirlooms of Scotland. The abbey was burned by the English in 1385, in 1544, and in 1547. It was made a chapel-royal in 1672. During the revolution of 1688 it was plundered and partially burned, and remained in a dilapidated state till 1758, when it was repaired and roofed; but the roof proving too heavy, it again became a ruin in 1768. It was restored in 1816.

In the year 1295 a Parliament was held in the abbey by John Balliol. James II. was born in it, and made it his home. James IV. laid the foundations of a palace in addition to the abbey, and Holyrood became the chief seat of the Scottish sovereigns. Queen Mary resided here, and it was in this palace, in 1566, that Rizzio was murdered. James VI. was born and lived in it until his accession to the throne of England, and visited it afterwards. Charles II. rebuilt it, and various royal personages occupied it till 1822, when George IV. held his court there, and it has been often visited by Queen Victoria.

HOL'YWELL, a town of Wales in the county of Flint, pleasantly situated on an eminence near the estuary of the Dee, 4 miles north-west from Flint and 195 miles from London by the North-western Railway. It was formerly an inconsiderable village, but the minerals of the neighbouring country, and the manufactures connected with them, have rendered it a flourishing town. The mines supply lead, copper, calamine, and other ores, and there are smelting-furnaces, copper works, brass works, wire works, a shot tower, &c. There are also manufactures of cottons, flannels, and galloons, paper, and cement. St. Winifred's Well was formerly much resorted to by a large number of pilgrims, its waters having been held in high repute for the cure of diseases. The spring throws out more than 80 hogsheads a minute, and over its octagonal well is a beautiful Gothic chapel, erected in the reign of Henry VII. From the well the water flows into a rectangular bath, 12 feet by 7, and the stream, in the short course of one mile, drives several mills. The harbour, from which the manufactures are shipped, is small and inconvenient. The town has a parish church and places of worship for dissenters. It is a contributory borough to the Flint parliamentary district. The population in 1881 was 11,329. Holywell is called in Welsh *Treffynnon*, the town of the well.

HOM'AGE, an incident of tenure during feudal times. The word is derived from Lat. *homo*, a man, because when the tenant did his service to the lord, he said, "I become your man," &c. *Liege* homage was that to the sovereign or lord paramount, and it could not be broken; but *simple* homage was binding on the tenant only while he held the fief for

which it was rendered. *Ancestral* homage was where the tenant and his ancestors had always held of the same lord and his ancestors. Homage was abolished by 12 Car. II. c. 21.

HOMBURG-VON-DER-HOHE, a town of Germany in the province of Hesse-Nassau, situated 10 miles S. by W. from Frankfurt-on-the-Main, under an eminence on which the palace of the landgrave is built. The resident population is 10,000. The town is charmingly placed amid the forest-clad hills of Taunus. It is much frequented for its mineral springs and baths. The waters, which contain common salt and carbonic acid, issue from the base of the Great Feldberg at the height of 600 feet above the sea; large quantities are exported every year. It formerly had the inglorious distinction of surpassing all the other gambling saloons of Germany in the magnitude of its transactions. Various unsuccessful attempts were made to suppress the gambling, which was carried on at all hours of the day and night, until the King of Prussia at last issued a peremptory order, under which they were entirely abolished in 1870.

HO'MER (in Greek *Homeros*), the supposed author of the earliest Greek heroic poems extant, and of some hymns in praise of different gods. Opinions the most various have been held regarding his birthplace, his age, his station, and the circumstances of his life. Seven places claimed to be the birthplace of "the blind old man of Chios' rocky isle:" Chios, Smyrna (the two earliest), Rhodes, Colophon, Salamis, Argos, and Athens. The author or authors of the Iliad appear from the work to have been accurately acquainted with the geography of Greece and the northern part of the Archipelago, and it has been inferred that Homer was a wandering minstrel. The existence of such wandering minstrels seems to be shown by the hymn to Apollo quoted by Thucydides; as the notices of Phemios and Demodokos, in the Homeric poems, prove the existence of bards attached to particular courts.

The poems attributed to Homer are the Iliad and the Odyssey, to which some have added the Homeric Hymns. Of these poems the Iliad stands first, as the oldest and at the same time the completest specimen of a national heroic poem. The subject is the revenge which Achilles took on Agamemnon for depriving him of his mistress Briseis during the siege of Troy, and the consequent evils which befell the Greeks. It is divided into twenty-four rhapsodies or books, which detail the history of the besieging force during the period of Achilles' anger, and end with the death of Hector (who is slain by Achilles in retaliation for Hector's having killed Patroclus) and the solemn burial of the Trojan warrior. Heroic poetry, as a simple form of art, does not employ the development of a plot, but rather the extraction of a certain portion from the poetical annals of a nation, beginning and ending just where the subject may seem to suggest, but not necessarily ending with a regular disengagement of a plot regularly worked up and studiously combined from the beginning of the poem. Whether what we now possess be the exact poem which thus forms the beginning of all Greek literature is scarcely doubtful. The lapse of so many ages can hardly have failed to have introduced some passages, and to have altered and removed others.

The Odyssey can hardly be called a national epic; it is much nearer the romance of chivalry than any other ancient work now in existence. It contains the account of those adventures which Ulysses (Odysseus) encountered on his way home from Troy, and in its present state consists of twenty-four books, which division is said to be owing to the grammarians in the time of the Ptolemies. There is little doubt that much has been interpolated in the account of Ulysses' visit to the Shades, and Aristophanes and Aristarchos the grammarians considered the latter part of the twenty-third and all the twenty-fourth book spurious. A characteristic of the Odyssey to which we have just alluded, is its romantic look, using romantic as opposed to classical. There is something quite northern in the adventures of Ulysses; they might have happened to a knight of Arthur's court, or perhaps still better to Beowulf. The Sirens would be singing maidens, who decoy travellers by their strains; the nymph Calypso would find an antitype in some enchantress. Ulysses slays the suitors much in the way of William of Cloudeslee in the old ballad.

The difference in the character of the Iliad and the Odyssey might lead us to the conclusion that these poems are not the product of the same mind. Other differences, however, of less importance have been pointed out by the critics. How far either poem can claim a single author is a still more difficult question. There is an historical fact which has been adduced in support of one side of this question, namely, the existence of a race of men called Rhapsodists or Homeridæ, who imitated Homer, enlarged upon him, and interpolated his poems with verses of their own, treating him very much as the Bible was treated by one school of the early mystery-mongers. Now those who deny the unity of the Iliad assert that these rhapsodists manufactured it among themselves, until it gradually assumed that form in which Peisistratos finally established it, and in which we now have it. [See Wolfian Theory of Homer in the article WOLF.] Whatever truth there may be in this opinion or any other as to the Homeric poems, we must admit that many lines, and even whole passages, may be interpolations. The hymns, epigrams, and the "Battle of the Frogs and Mice" make up the sum of the Homeric poems, genuine and spurious. The earliest mention made of Homer is by Pindar. Herodotus and Thucydides quote and refer to him; and by Plato he is constantly either hinted at or transcribed.

The principal modern editions of Homer are those by Wolf (Leipzig, 1807), Bekker (Bonn, 1858), and La Roche (Leipzig, Odyssey, 1868, Iliad, 1876) ;and good commentaries exist by Heyne and Nitzsch, for the Iliad and Odyssey respectively. A fine collection of scholia was published by Oxford University in 1880. Of translations we have Hobbes, Chapman, Pope, Cowper, Sotheby, Worsley, and Lord Derby. Although the Odyssey of Worsley (Blackwood, 1861) has received special marks of public approbation, perhaps, on the whole, Lord Derby's (1864) is the better. Nothing, however, equals Chapman in general representation of the original in English. Its antique rugged grandeur is magnificent. Pope is trivial by its side, and Derby is essentially modern. Keats' sonnet on this translation of Chapman's is a noble piece of enthusiastic work. Chapman was published for a shilling in Morley's Universal Library in 1884, and it is creditable to the public that it met with a large and ready sale. Chapman uses rhymed fourteen-syllabled couplets; Pope rhymed ten-syllabled or "heroic" couplets; Cowper and Derby use blank verse. The German translation by Voss is wonderful as regards accuracy. It is in hexameters, and preserves every sentence, and nearly every word. In Italian the translations of Cesarotti and Monti, and in French that of Montbel, are the best known.

As for the approximate date of Homer, Clinton gives 962–927 B.C., but Grote, after much careful research, thinks him not older than from 850 to 776 B.C. The date of 1184 B.C. given by Dionysius is of course absurd.

HOMESTEAD ACT, a very important Act passed by the Congress of the United States with the view of promoting the cultivation of land in the more recently settled states. It gives to every citizen—without payment—the right to a homestead on surveyed lands to the extent of one-quarter of a section, or 160 acres; and after five years settlement on and cultivation of the soil a complete title for the homestead is given to the settler. Aliens

cannot acquire valid titles to real estate under the pre-emption and homestead laws.

HOMICI'DAL MA'NIA is the name given to a form of impulsive insanity in which the patient seems to be impelled by a blind overmastering desire to take life. The records of medical jurisprudence contain many cases of unpremeditated, purposeless murder committed by persons who had previously displayed few if any of the signs of insanity. Very often the victim selected has been one who was previously greatly beloved, though sometimes a perfect stranger has been sacrificed in this way. Occasionally persons who have felt this impulse gradually coming upon them have struggled for a time successfully against it, and at last finding it becoming overmastering have voluntarily sought restraint. In other forms of this disease the murder has resulted from delusions on the part of the insane person, such as the hearing of a miraculous voice from heaven commanding the act, or that it is necessary as a means of self-defence against poisoning, &c.

In such cases careful investigation generally shows either the existence of strong hereditary taint or of some form of brain disease, but it is very often a most difficult problem to estimate how far such a person must be held responsible for his actions. According to English law every person is assumed to be responsible for his acts unless the contrary is proved, and though the plea of insanity as a defence for the crime of murder is sufficient when it can be sustained, it is usually regarded with a good deal of suspicion both by judges and juries in cases where the accused person has been at large previous to the commission of the crime.

HOM'ICIDE, in English law, is defined as the killing of a human being, whether such act be criminal or not. Three kinds are recognized—justifiable, excusable, and felonious. *Justifiable homicide* is that which has no guilt at all, such as when the proper officer executes a criminal in strict conformity with the sentence of the law, or where an officer of justice or other person acting in his aid in the legal exercise of a particular duty kills a person who resists or prevents him executing it, as when a person resists arrest with violence and is killed in the struggle, or where persons are killed by the officers in dispersing a riotous mob, &c. Homicide is also justifiable where it is committed to prevent the perpetration of an atrocious crime attempted with violence, such as rape or murder, and most probably housebreaking during the night.

Excusable homicide is of two kinds—(1) where a man doing a lawful act unintentionally kills another by misadventure; and (2) where it is committed in self-defence, the slayer being in imminent danger of death, and having done all he could to avoid the assault. The latter kind includes the committal of homicide in the defence of others, such as wife or children, whom it is a duty to protect. The plea of self-defence will not hold good in the case of unlawful acts, such as duels or prize fights, and in such cases seconds and those who assist are regarded by the law as sharing in the guilt of the principals.

Felonious homicide is the highest offence known to the law, and it implies the killing of a human creature of any age or sex without justification. For the law relating to this see under MANSLAUGHTER, MURDER, and SUICIDE.

The law of Scotland is practically the same. Instead of felonious homicide, "culpable homicide" is the technical phrase. Under an indictment for murder a verdict of culpable homicide may always be returned.

HOM'ILY (Gr. *homilia*, converse), in ecclesiastical matters, is a familiar and homely discourse on a religious subject. The practice of translating the Hebrew into the vernacular when the lessons were read in the Jewish synagogues had prevailed for a period long before the institution of Christianity, and so apparently had the custom of offering an exposition of the passage read with an application to the case of the hearers (see Luke iv. 16–27), and the latter custom passed readily into the usages of the Christian church. In course of time a distinction was made between the expository addresses based upon the lessons for the day and the more complete lectures and sermons, and the custom of writing homilies or expositions for general use became established. In cases where the minister of a church was unable through want of ability or illness to deliver a sermon, a written homily was generally substituted, and collections of these, known under the title of Homiliaria, were in use from a very early period. Many of the more eminent of the fathers devoted attention to the composition of homilies, and during the dark ages their use by the clergy became almost universal. The collections in use, however, were very imperfect and corrupt, and towards the close of the eighth century Charles the Great ordered a compilation to be made by the deacon Paul Warnefred, which was issued under royal authority, and contained 176 homilies arranged in order for all the Sundays and festivals of the ecclesiastical year. This collection continued in use down to the sixteenth century, and it was printed at Spires in 1482, and at Cologne in 1557. An English Homiliarium was compiled by Ælfric (1023–51), and a metrical collection of homilies was also composed about the middle of the thirteenth century. A portion of this was published in 1862 under the editorship of Mr. J. Small, librarian to the University of Edinburgh.

The Books of Homilies of the Church of England consist of two collections, the first of which was published in 1547, the first year of the reign of Edward VI. It contained twelve homilies, which were composed by Cranmer, Latimer, Bonner, and others, and which were ordered to be read in all churches throughout the kingdom. The second collection, which is that referred to in the thirty-fifth article of the Church of England, was issued along with the thirty-nine articles in 1563.

HOM'INY is the flour of MAIZE or Indian corn, as prepared in America. In the Italian form of *polenta* it forms the staple food of the poorer people of the peninsula. Hominy has been much used in England of late years, both in the form of porridge and of puddings: in the latter form it has a certain resemblance to rice similarly prepared.

HOMOCU'MINIC ACID or **CY'MINIC ACID**, an acid obtained from cyanide of cymyl, by acting on it with boiling solution of potassa. It is homologous with cuminic acid. It is a crystalline acid, melting at 52° C. (126° Fahr.) and distilling without change. It is soluble in alcohol, ether, and boiling water. The formula is $C_{11}H_{14}O_2$. It forms a number of crystalline salts, called homocuminates.

HOMŒOP'ATHY (*ὁμοιοπάθεια*), a mode of treating diseases in virtue of a generalization made and promulgated by Dr. Hahnemann, a German physician who was born in 1755, which has gained many converts among the medical profession in all civilized countries, though it is still rejected by the great majority. As its name implies, its adherents maintain that in selecting a drug for the cure of any particular disease, a substance ought to be chosen and administered in minute doses, which, if given in large doses, would produce in the human organism a state identical with, or as similar to as practicable, the diseased condition which it is sought to alleviate. It is usually expressed by the maxim *similia similibus curentur* ("let like be treated with like"). This is often quoted *curantur* instead of *curentur*, which, by a combination of mistranslation with misquotation, is popularly supposed to mean "like *is cured* by like"—a great mistake, for the maxim is not looked upon by the most intelligent of Hahnemann's disciples as an expression of a natural law, so much as a practical rule founded on some law or laws of biology not yet fully understood. The paradox apparently involved in it may perhaps seem less absurd if we consider that it is now admitted by all the most advanced students of therapeutics,

that all or at least the great majority of medicinal substances and poisons produce in the animal body, when given in small quantities, effects apparently opposite to those which they cause when given in large doses. The *Lancet*, the leading English medical journal, the great weight of whose authority in the ordinary practice is admitted by every one, expressly laid this down in an editorial article of 14th May, 1881, as "the universal law of therapy," and in another number soon after gave various examples of this alleged law. Many instances in point are familiar to everyone, such as the stimulating and enlivening effects of opium and other narcotics when used sparingly, contrasted with the stupor which ensues from larger doses, resulting in death itself if the quantity be increased. The effect of certain emetics in curing sickness and vomiting when minute doses are used is also pretty well known, and such instances might be multiplied indefinitely. The admitted condition of the capillary bloodvessels in congestion and inflammation (the same vessels being constricted in the first stage and dilated in the second stage of the morbid process) suggests a similar idea, for it may be that an *irritant* applied *very gently* to an inflamed tissue during the second stage may have the effect of restoring the vessels to the constricted condition, or of affecting them in that direction, while in itself too weak to induce a second or dilated stage of its own.

All this points to the conjecture that there may lie a deep truth imbedded in the homœopathic doctrine, the fundamental principle of which may be, though somewhat popularly and vaguely, described as one of *reaction*. However this may be, many of the more enthusiastic homœopathists have shown a zeal which, whether their general doctrine be true or untrue, certainly is creditable to them, for they have collected an enormous mass of material illustrative of the effects of innumerable drugs on the healthy body, often at the expense of no small suffering to themselves. Much of this material may possibly yet be utilized by those who have no faith in the maxim *similia similibus*.

Another doctrine maintained by Hahnemann was that drugs by infinite subdivision attain a degree of medicinal power which they do not possess in masses, and that a diseased tissue is exquisitely sensitive to the action of whatever substance has the power of affecting that special part of the organism. How far these are essential portions of the homœopathic theory need not here be determined, especially as the homœopathic physicians are not themselves quite at one on the point; but all are agreed that in order to subdue a disease, the appropriate remedies must be given in quantity *below* that which would induce in a healthy man phenomena akin to those of the disease in question.

At present the homœopathists maintain that the orthodox practitioners (whom some among them call *allopathists* by way of distinction) are every day largely borrowing from their resources—as, for example, in the increasing practice of using only one or very few medicines at a time, and also in the frequent announcement *as a discovery* of some drug the utility of which the homœopathists have long known; while the orthodox assert that genuine homœopathy is rapidly disappearing, and that its advocates merely retain the name in order to attract a certain section of the public. *Non nobis tantas componere lites.* Most people still think it safer to go along with the majority of those who must be considered experts. Another generation will probably see the extinction of what error may be in such doctrines as those of Hahnemann, while what truths they contain will be absorbed into the general code of a more advanced school of therapeutics. In all speculations in regard to the cure of disease, one consideration must manifestly be kept in view, namely, that until we discover, in the progress of pathological science, that there is *some one element* (other than the mere quality of being abnormal and inconvenient) *common* to all kinds of diseased action, it is vain to seek for anything like a universal principle of cure. In order to render a single and universal principle of treatment possible, there must be something single and universal in all those morbid conditions which that principle is capable of attacking.

The astounding fluctuations of treatment among the most authoritative practitioners during the last half century, which have been patent enough to every intelligent onlooker, are certainly not very hopeful signs of progress in the healing art. That pathology and diagnosis, as well as mere hygiene, have made great progress in the period is generally admitted, and many improvements in the mechanical appliances of surgery have been made; but therapeutics, in the sense of the science of the action of drugs, seems to be still in little more than an embryo condition.

It was by disgust at the uncertainty of the practice of his day that Hahnemann himself was at first driven to abandon his profession. He afterwards saw, as he thought, a gleam of light in the midst of darkness, by discovering a close similarity between the symptoms produced in healthy persons by overdoses of cinchona (Peruvian bark) to those of certain types of intermittent fever, for which that medicine is a specific. Starting from this he instituted an extensive series of experiments which lasted throughout a very long life, during which he underwent great persecution at the hands of orthodox practitioners. Homœopathy was the result of these experiments. In virtue of the doctrine of the "survival of the fittest," in its application to human opinion and practice, the present strife of homœopathy and the so-called allopathy may, nay *must*, in time result in the elimination of something like truth and certainty.

HOMOGE'NEOUS and **HETEROGE'NEOUS** are terms applied in mathematical language to expressions which have or have not the same number of factors of a given sort in each term. Thus, with respect to x and y, $ax^2+bxy+cx^2$ is homogeneous, but ax^2+by is heterogeneous.

HOMOL'OGOUS, a term applied in mathematics to those magnitudes which, being of the same kind, occupy different places in a proportion, one being an extreme and the other a mean. Thus in the proportion A is to B as C is to D, A is homologous to C and B to D.

HOMOLOGOUS SUBSTANCES. These are organic compounds differing from each other by CH_2, or any multiple of CH_2; as, formic acid, CH_2O_2; acetic acid, $C_2H_4O_2$; propionic acid, $C_3H_6O_2$; butyric acid, $C_4H_8O_2$; and many others. Bodies in homologous series show regular gradations of boiling-points, the temperature rising for each addition of CH_2. The chemical properties become less energetic as the bodies rise in the series; and the physical characters also are changed, becoming more solid or crystalline at each step. The alcohols corresponding with the acids exhibit a similar gradation of properties.

HOMOL'OGY, in anatomy, a term derived from the Greek *homos*, like, and *logos*, a discourse. It is often popularly used as if it were the same as *analogy*. But this is not correct. Homology is the relation between organs or parts of the body which are constructed on the same plan, however much they may vary in form, or serve for different uses. Thus there is a homology between the arm of man, the fore leg of the horse, the wing of birds, and the pectoral fin of the cod, because, though used for different ends, they are constructed on the same plan; but there is no analogy. On the other hand, there is an analogy between the wings of the butterfly and those of birds, because both serve for flight.

HOMOOU'SION and **HOMOIOU'SION.** It is scarcely possible to exaggerate the importance which was

attached to the distinction between these words in the early church, although, as will be seen, it consists only of a single letter. The first signifies "the same substance" (*homos*), and the second "like substance" (*homoios*). The former was the watchword of orthodoxy in the celebrated Arian controversy and at the Council of Nice (Nicæa, 325), which declared the Son to be of the same substance as the Father. The Arians, on the other hand, held the subordination of the Son. The more moderate of them (the "semi-Arians") later on, with a view of healing the breach, proposed to substitute *homoiousion*, *i.e.* a being of similar but not identical substance (Council of Seleucia, 359). The church was distracted for many years by the ceaseless strife of the Homoousians and the Homoiousians, for the latter, while they had abandoned the strict Arian standpoint, had not in the least conciliated the orthodox.

HOMOP'TERA is a suborder of the order of insects Hemiptera; by some authorities it is regarded as an order. The insects of this group are thus characterized:—Rostrum arising from the lowest part of the head near the chest; the elytra are of the same consistence throughout, semimembranous, and sometimes resembling the wings; the three segments of the thorax are blended, and the first is often shorter than the one succeeding.

In the typical Homoptera the head is large, broader than long; the eyes are large, and there are ocelli, or simple eyes, between them; the antennæ are minute, composed of but few joints, and terminated by a bristle; the rostrum is a slender-jointed process, which lies close to the chest; the legs are of moderate size; the hinder tibiæ are usually spined; the body is convex above and flattish beneath; the wings are semimembranous, the anterior pair or elytra often opaque, sometimes transparent, and always of a uniform texture throughout. The larvæ are active and resemble the perfect insect, excepting that they possess no wings; the pupæ are also active, but possess rudimentary wings.

These insects feed upon vegetable juices. The females are furnished with an ovipositor, composed of three denticulated blade-like processes, which are lodged in a groove in the abdomen. By means of this ovipositor they pierce holes in vegetables, in which they then deposit their eggs. Many homopterous insects possess the power of leaping by means of their posterior pair of legs.

This group includes the cicadas, frog-hoppers, lantern-flies, scale-insects, and plant lice. The families are noticed in the article HEMIPTERA.

HOMOTAX'IAL STRATA, in stratagraphical geology, are beds that bear to each other a similar relative position without necessarily being of identical age or containing similar fossil remains. Thus the CRETACEOUS of England consists largely of chalk, whereas in the equivalent or homotaxial beds in Western America chalk is altogether absent, its place being taken by ordinary sands, clays, and limestones, with beds of lignite.

HONAN', an inland province of China, mostly between lat. 32° and 37° N., and lon. 110° and 116° E. The area is stated to be 66,913 square miles, and the population 30,000,000. Its northern part is intersected by the Hoang-ho, and all its streams are affluents of that river. It is considered the most fertile and salubrious province in China, and was the seat of government for many centuries, when it was named Chung-wha, or *Central Flower*, and hence the title of Central Flowery Land applied to the whole country. It is the residence of the remnant of the Jews in China.

HONDU'RAS, a republic of Central America, situated in lat. 13° to 16° N., and lon. 83° to 89° W. It is bounded on the north and east by the Caribbean Sea and Mosquitia; west by Guatemala; south, by Salvador and the Bay of Comayagua on the Pacific; and south-east, by Mosquitia and Nicaragua. It is traversed by several subordinate ridges of the great cordillera, between which lie many rich valleys. Much of the surface is richly timbered, and there are also extensive pasture tracts, on which fine cattle are reared. It has considerable mineral wealth in mines of gold, silver, platinum, copper, iron, antimony, mercury, zinc, and tin, with many beautiful minerals, as opal, emeralds, asbestos, &c. So little elevated is the surface along an undulating east and west line that a railway has been proposed from Port Caballos, on the Bay of Islands, to the Gulf of Fonseca, on the Pacific; total distance, 225 miles. The chief river is the Ulua, which drains nearly a third of the entire state. It is navigable for small steamers for the greater part of its course. The exports are of the same vegetable products as in the other states—namely, cotton, sugar, tobacco, coffee, indigo, mahogany, dye-woods, &c. The state has a debt of £5,990,108, chiefly contracted for the scheme of an inter-oceanic railway capable of transporting ships. It was at Cabo de Honduras that Columbus first touched American soil in 1502. On the plain of Comayagua are some remarkable ruins. The chief ports are Truxillo, on the Caribbean Sea, and Port San Lorenzo, in the Bay of Comayagua. The republic consists of a senate of seven members, a legislative chamber of fourteen deputies, and a president elected by the two chambers. The area is about 40,000 English square miles, and the population is estimated at 300,000, chiefly aborigines.

HONDURAS, BRITISH. See BRITISH HONDURAS.

HONE, WILLIAM, an English satirist, antiquarian, and political writer, was born 3rd June, 1780, at Bath, where his father is stated to have been an occasional preacher among the dissenters. After being engaged for some years as an attorney's clerk at Chatham and in London, William quitted the law, and having married, set up in July, 1800, as a bookseller in Lambeth, and afterwards in three or four other places in London, in all of which he was unsuccessful. In 1811 he took a humble lodging in the Old Bailey, and endeavoured for a time to support his seven children by contributing to periodical publications, especially the *Critical Review* and the *British Lady's Magazine*. At length, however, he found means to set up once more as a bookseller in a small shop in Fleet Street. Here he was again unfortunate in having his premises twice broken into and plundered. In 1815 he became publisher of the *Traveller* newspaper. In 1816 he commenced a weekly paper called the *Reformists' Register*. The next year he brought himself into great notoriety by a series of political satires, which had immense success, the effect partly of the woodcut embellishments from the designs of Mr. George Cruikshank. Those of the series that turned out the most productive for the author were three composed in the manner of parodies upon various parts of the Book of Common Prayer. For the printing and publishing of these parodies Hone was brought to trial on three several indictments in the Court of King's Bench, on the 18th, 19th, and 20th December, 1817. He defended himself on all the three trials, which were before special juries, and notwithstanding the exertions of the prosecution to procure a conviction, was acquitted on each indictment. His acquittal was followed by the subscription of a considerable sum of money for his use, which enabled him to remove from Fleet Street to a large house in Ludgate Hill, where he continued a few years, but was unsuccessful. In 1823 he published the results of researches to which he had been originally directed with a view to his defence, in an octavo volume entitled "Ancient Mysteries Described, especially the English Miracle Plays founded on Apocryphal New Testament Stories extant among the unpublished MSS. in the British Museum." In 1826 Hone began the publication, in weekly numbers, of his "Every-day Book." The sale was large, but his family had now increased to ten children, and he again got into difficulties, the end of which was that he was arrested by

a creditor and thrown into the King's Bench Prison. Here he remained for about three years, during which time he finished his "Every-day Book," in two volumes, and began and finished his "Table Book," in one volume, and also his "Year Book," in one volume. In 1838 Hone did the antiquarian world the great service of republishing and carefully editing Strutt's "Sports and Pastimes of the People of England."

During the latter years of Mr. Hone's life he was employed as sub-editor of the *Patriot* newspaper. He died at Tottenham on the 6th of November, 1842.

HONES or **WHET-STONES** are stones used for the purpose of whetting or sharpening knives, scythes, and edge tools. They are generally prepared in the form of flat slabs or small bars or rods, though some are specially shaped for particular instruments. Their abrading action is due to the presence of silica in a finely divided state, and they are used either dry, dipped in water, or rubbed with oil. The finest kinds of hones are those termed oil stones, and some of these are so compact and hard that they readily sharpen the hardest steel blades, and even resist the pressure required for sharpening gravers. Many excellent varieties are found in Great Britain, the Welsh, Devonshire, Leicestershire, Yorkshire, and Fifeshire stones all having special reputations, but the finest hones are those brought from the hot springs of Arkansas in America, and the stones brought from Turkey. The celebrated Water-of-Ayr stone is used for polishing copper-plates as well as for hones, and the greenstone from Snowdon is used to finish the edge of surgeons' lancets. The hones used for sharpening scythes, the cutters of mowing machines, and similar purposes, are made of gritty sandstones known as bat or scythe stones.

HONEY is a fluid or semifluid substance, the materials of which are collected by different kinds of bees, in Europe chiefly by the *Apis mellifica* or hive-bee [see BEE], and solely by the neuter or working bees, from the nectariferous glands in the cup or chalice of flowers. It cannot be said to be a purely vegetable production, for, after being collected by the proboscis of the insect, it is transmitted to that distension of the œsophagus termed the crop, sucking-stomach, or honey-bag, where it is elaborated, and again disgorged, to be deposited in the cell of the honeycomb. It undergoes less change when the bees are very young, remaining nearly white, and is then denominated virgin honey. The honey obtained from old hives is usually darker and thicker, while it is less pleasant to taste and smell than the virgin honey. At all times it retains qualities derived from the kind of plant whence it has been procured, as is manifest not only by the peculiar odour of the honey, but by the effects which follow the use of honey obtained from certain plants, chiefly of the subtribe Rhodoraceæ, such as the azalea, rhododendron, kalmia, &c., which yield a honey frequently poisonous. The description given by Xenophon of the effects of the honey of Trebizond, which produced temporary insanity, or a condition resembling drunkenness in all who ate of it, is well known, and recent travellers in that district have found that the honey gathered there still possesses the same properties.

Honey is sweet, faintly aromatic, granular, soluble in water, and capable of undergoing the vinous fermentation, and so yielding an intoxicating drink called hydromel, metheglin, or mead. Honey is certainly nutritive, but it cannot be employed to any great extent, since if taken in considerable quantity it excites the action of the bowels, and is gently laxative. Its effects in this way will be greater in proportion to its age and acridity, and less, or scarcely appreciable, when largely diluted with water. In the latter state it is rather demulcent, emollient, and refrigerant, and hence forms a good drink in fever and other inflammatory complaints, but it should not be taken if there be much gastric or intestinal irritation. It is used likewise in catarrhs, and when drunk warm is considered to be expectorant. Along with vinegar it forms a good gargle in slight cases of sore throat, and combined with borax a most efficacious application in aphthæ of the mouth and throat.

In addition to the large quantities that are produced at home, of which no estimate can be given, from 15,000 to 20,000 cwts. of honey are annually imported into the United Kingdom. The best description comes from France and Greece, the latter being generally deemed a table delicacy. In the United States of America much attention has been given of late years to the production of honey, and a large number of persons are there employed exclusively in bee-keeping. Some of them keep as many as 2500 or 3000 hives, and one large apiarian has fifteen men in regular employment on his honey farm. The best district in the States is that known as the "bee-belt" of California, where the hill-sides and valleys are covered with flowering plants from which an aromatic and delicious honey is extracted by the bees. This is chiefly used as an article of diet, but another and inferior kind obtained from buckwheat blossom is largely employed in brewing beer and in the preparation of cough medicines. More attention has also been given to bee-keeping in the United Kingdom during the past few years, and many improvements have been introduced, and although it is impossible that honey should ever regain the value it possessed when sugar was unknown, yet from the annual increase in the amount produced it appears likely to become again an important article of commerce. The coarser kinds are sometimes used to give a spurious sweetness to tobacco. Honey is often adulterated—generally with flour; but the chief impurities rise to the surface if it is gently heated, and may be easily skimmed off.

HONEY-BUZZARD (*Pernis apivorus*) is more nearly allied to the kites than to the buzzards. This bird is remarkable for its habit of breaking up the nests of humble-bees and wasps to feed on the larvæ. Insects are the chief food of the honey-buzzard, the larvæ of wasps and bees being mixed with caterpillars and beetles and their larvæ; in one examined by White of Selborne the stomach contained the limbs of frogs and a great many gray slugs. These birds have, however, been captured in traps baited with young rabbits; they have been seen to strike and carry off young pheasants; and a specimen kept in confinement killed and ate rats, as well as birds of considerable size, with great ease and appetite. It also feeds on buds, berries, and leaves.

The honey-buzzard inhabits during summer most parts of Europe, but is somewhat rare in this country; in winter it visits Africa. It has rather a weak bill, curved from the base, which is covered by a large cere. The spaces between the base of the bill and the eyes are covered with small feathers. The tarsi are reticulated. The honey-buzzard measures from 22 to 25 inches in length. Its plumage is soft and kite-like. The colour of the upper surface is brown, with the primaries blackish; that of the lower surface is a pale yellowish-brown. The top of the head is bluish in the male, whitish with brown spots in the female; the tail feathers are barred with brown. The beak is black, with the cere gray, and the feet yellow, with black claws. The honey-buzzard is rather timid and inactive, rarely flying, except from one tree to another, and never rising to any great elevation; on the ground it runs with great rapidity, almost like a fowl. Its nest is built in some high tree in a wood or forest, and is composed of twigs and lined with dead leaves. The eggs, which vary from two to four in number, are blotched over with two shades of orange-brown.

HONEYCOMB. See BEE.

HONEY-DEW is a popular name given to sugary excretions on the leaves of plants, but more particularly to

the sweet excretions from the bodies of aphides. Honey-dew is found on the leaves of several species of acacia, secreted by special glands, as well as on those of laurustinus, tamarisk, and ash. The honey-dew excreted by species of ash and tamarisk is generally known as manna. The aphides feed on the sweet juice of leaves by puncturing them; they reject a portion of it in many cases by means of two tubes on their back, and it is this honey-dew which ants are so fond of that they actually keep aphides and milk them. See ANT and APHIDÆ.

Kerner, in his "Flowers and their Unbidden Guests," gives an account of nectaries at the base of the leaf-stalk of a balsam (*Impatiens tricornis*). They are placed transversely in front of the axil from which the flower-stalk springs, in such a way that any insect creeping along the stem must, in its way to the flowers, pass over them. The honey is so abundant that ants do not pass beyond them to get at the nectar in the flowers. Dr. Kerner points out that this diversion offered the ants by the way protects the flowers from being rifled of the honey, which acts as an inducement to flying insects to visit and cross-fertilize them—a service which the ants would fail to perform.

Belt, in "The Naturalist in Nicaragua," states that the bull's-horn thorn, a species of Acacia, has a crater-formed gland at the base of each pair of leaflets, which secretes a sweet liquid when the leaves are young. This honey, together with small yellow bodies situated at the base of each pinnule, affords ample food for the ants, while the hollow horns provide space for their nests. The Guelder Rose (*Viburnum Opulus*) has glands on the leaf-stalks. An East Indian elder tree (*Sambucus javanica*) has honey-cups not only on the leaf-stalks, but scattered about among the flowers. Passion-flowers also are provided with glands on the young leaves and the sepals of the flower-buds; and it is quite possible that in several cases, at any rate, they may serve as an attraction for ants, which protect the tender foliage and flowers from being devoured by other ants and insects.

HONEY-EATER is the common name given to the members of the Meliphagidæ, a large family of Passerine birds peculiar to the Australian region. The honey-eaters have usually a long, curved, and acute bill, of which the upper mandible is generally notched faintly at the tip; the nostrils are placed in a large groove, and usually covered with a membranous scale; the tail is elongated and wedge-shaped, and the first three quills of the rather short wings are graduated—that is, they gradually increase in length to the third; the tarsi are short and stout, and terminated by long toes, of which the outer is always united to the middle one at the base. Another character presented by these birds consists in the structure of the tongue, which is not only long and protrudible, as in the humming-birds, but furnished at its tip with a small tuft or brush of delicate filaments, which are of the greatest service to the birds in sweeping out the honey and pollen, and with these the minute beetles and other insects from the flowers which they so assiduously frequent. These substances constitute the food of nearly all the species, although some also capture insects from the leaves and branches of trees, and a few are said to feed partly upon fruits. Few of them possess any power of song. Over 200 species have been described.

The Common Honey-eater (*Meliphaga novæ-hollandiæ*), the type of the representative genus of this family, is one of the most abundant birds in the southern and eastern colonies of Australia and in Tasmania, but does not occur in Western Australia. It is not migratory, though it appears occasionally to quit one district for another, probably in search of some more attractive food; but from its partiality for the Banksiæ, which grow principally on barren sandy districts bordering the coasts, it is usually seen most abundantly in the vicinity of the sea, and becomes more rare in the interior of the country. The total length of this bird is about 7 inches. The upper surface is brownish-black, the lower surface white streaked with black; the head and cheeks are black, with the forehead, a streak over each eye, and a small patch behind the ears white; the quill feathers of the wings and the lateral feathers of the tail are broadly margined externally, from the base to near the tip, with bright yellow; the two centre feathers of the tail are entirely brownish-black; the remainder have a white spot at the tip. This bird breeds commonly in the gardens of the colonists, and rears two or three broods in the season. The nest is usually placed in a shrub or bush at about 18 inches or 2 feet from the ground; it is composed of sticks, grass, and bark, and lined with vegetable downy matter. The eggs are two or three in number, of a pale buff colour, and speckled with chestnut brown, especially towards the larger end.

The Singing Honey-eater (*Ptilotus sonorus*) is one of the few honey-eaters that possess any power of song; its song is said to resemble that of the missel-thrush. In the genus Myzomela the plumage often varies in the sexes; in one species, *Myzomela sanguinolenta*, the soldier-bird of the colonists, the male is a brilliant scarlet, with the wings and tail black; the female is brown. The PARSON-BIRD (Prosthemadera), WATTLE-BIRD (Anthochæra), and FRIAR-BIRD (Tropidorhynchus) also belong to this family.

HONEY-GUIDE is the name given to birds of the genus Indicator, from their habit of guiding men to bees' nests containing honey. This genus was formerly classed in the cuckoo family (Cuculidæ), but is now made the type of a distinct family, Indicatoridæ. Eleven species have been described, eight African and three Asiatic. The first species known was described by Sparrman in 1771. This species (*Indicator sparrmani*) is of a rusty-gray colour above, having the wings brown, with a yellow spot at the bend. It is about 6 inches, and inhabits Southern Africa. It feeds upon bees and the contents of their combs. The honey-guide seeks out the nests of the wild bees, which are generally built in holes of trees. By their cries when haunting the vicinity of a wild hive these birds often lead the natives to the place. It is even asserted that they guide men intentionally to hives in order to procure more readily their favourite food. The Ratel or Honey Badger (*Mellivora capensis*), one of the weasel family, is often led by the cries of the honey-guide to places where a rich store of honey awaits it. The honey-guide flies heavily and only for short distances, but runs upon the trunks and branches of trees with great agility. Some uncertainty exists as to their mode of breeding, some authorities asserting that they build pensile nests, others that they are parasitic, like the cuckoo. The peculiar habits are not possessed by all the species. The bill is short and straight; the wings are lengthened and pointed; the tail is moderate and rounded; the feet short, with the toes placed in pairs, two before and two behind.

HONEYMOON, the name by which the first month after marriage is popularly known. It was formerly the custom among Teutonic nations to drink hydromel, a liquor made from honey, for a month or moon's age after the wedding feast, and hence the name.

HONEYSUCKLE (Lonicera), a genus of plants, the type of the order CAPRIFOLIACEÆ. There are about eighty species of Lonicera, most of which have handsome flowers and emit a delicious perfume. *Lonicera Caprifolium* (goat's-leaf) has a twining stem, with white or purplish sessile flowers and orange-coloured berries; it is specially remarkable for the upper pairs of leaves being so united as to look like one leaf through which the stem passes. It is a native of the middle and south of Europe, and is found in woods and thickets in many parts of England and the south of Scotland. *Lonicera Periclymenum*

(woodbine) has climbing branches, stalked flowers of a pale yellow, and red berries. This plant in early times was supposed to possess powerful medicinal properties, but it is not now used. It is, however, extensively cultivated in the gardens and shrubberies of Europe on account of the delicious perfume of its flowers. It is a native of middle Europe, and very abundant in some parts of the British Isles. *Lonicera Xylosteum* (fly honeysuckle) is a native of nearly the whole of Europe, in thickets, hedges, and rocky places, and by the side of woods. It is found in the same situations, but is a rare plant, in England. It occurs in Sussex, Hertfordshire, &c., but probably is only naturalized. It is known from the former species by having two flowers on each stalk. It has pale yellow flowers and scarlet berries. *Lonicera tatarica* (the Tartarian honeysuckle) is a native of Tartary, and is one of the most hardy of European shrubs, growing in the open air in the gardens of St. Petersburg and Stockholm. It is very common in British gardens, and is valued much on account of its early leafing and flowering. *Lonicera sempervirens* (the trumpet honeysuckle) is a native of the Southern United States. It is a subevergreen, and is often cultivated, for although the flowers are not fragrant they are of a brilliant scarlet colour, and grow in large clusters. *Lonicera japonica* (the Japan honeysuckle) is a very valuable species for the garden, as it is hardy and nearly evergreen. The flowers are red outside and white inside, very fragrant, and with proper pruning and watering produced in the open air from April to November, and in the conservatory all the year round.

All the species of Lonicera are well adapted for gardens, shrubberies, &c. In Lonicera the calyx-limb is small, with five teeth; the corolla is tubular or funnel-shaped, five cleft, generally irregular. There are five stamens. The style is filiform, the stigma capitate, and the fruit is one to three-celled, with few seeds. The name is given in honour of the German botanist, Lonicer. The Old English name, *huni-suge*, was applied chiefly to the privet, and meant that from which honey could be sucked. In some parts of England, and by agriculturists, the name honeysuckle is applied to Clover (*Trifolium pratense*). In Australia the colonists transferred the name to species of BANKSIA. French honeysuckle is a species of HEDYSARUM. The white or swamp honeysuckle of North America is *Azalea viscosa*. The flower of the honeysuckle, decoratively treated, is one of the most beautiful and favourite ornaments in Assyrian and Greek architecture.

HONFLEUR, a seaport of France, in the department of Calvados, opposite to Havre, stands at the foot of a high hill on the left of the mouth of the Seine. The town contains many quaint and picturesque old wooden houses, and its situation, backed by wooded heights, is pleasing. There are a pier, harbour, and three floating-docks, and a good deal of trade in timber, coal, &c.; great quantities of eggs are exported to England, besides live cattle, butter, and fruit. The Church of St. Catharine is large and remarkable, entirely of timber and plaster, probably the largest of its kind in France. The chapel of Notre Dame de Grâce (1606), situated on the hill above the town, somewhat to the west, is much resorted to by sailors. It was formerly not uncommon for the crews of vessels which had escaped dangers at sea to make a pilgrimage hither in their shirts, barefooted and bareheaded. The population of Honfleur in 1881 was 9477.

HONG-KONG or **HIANG-KIANG** ("Fragrant Streams") is one of the group of rocky islands situated at the mouth of the Canton River, about 37 miles south of Macao and 100 from Canton. It is separated from the mainland of China by a narrow strait, which varies from less than a mile to 4 or 5 miles in width. The island is about 11 miles long, with a breadth of from 2 to 4 miles. Its area is 29 square miles.

Hong-Kong was taken possession of by the British during the first war with China, and was formally ceded to them by the treaty of Nankin, 30th August, 1842. On the 26th June, 1843, it was regularly constituted a British colony. It is what is called a crown colony—that is, it has no legislative assembly, but is governed by orders from the colonial office in London. There is a legislative and executive council to aid the governor with their assistance and advice. The offices of the government are at Victoria, the chief town. There is a chief-justice and attorney-general, with other law officers, and the usual departments of a colonial administration.

At the time when the British first occupied Hong-Kong the number of Chinese inhabitants was supposed to amount to only about 5000, consisting chiefly of fishermen and smugglers. Since it became a British colony there has been such a great increase of Chinese that the total population in 1881 was 160,402, of which number 7990 were whites, 1722 coloured, and the remainder Chinese. The resident whites only number about 3000—the remainder consisting of the naval and military services and the crews of merchant ships in the harbour. In fact, the constituting of the capital of Hong-Kong a free port, and the security of life and property under the British government, have rendered this otherwise undesirable spot the concentrated mart for all the trade with the neighbouring mainland; and although the island is capable of growing scarcely anything to support its inhabitants, it is probably, for its size, the richest spot in actual wealth on the globe.

The northern side of the island is traversed by a ridge of mountains, which vary in height from 500 to upwards of 1800 feet, three of the summits being 1575, 1711, and 1827 feet high respectively. The south side is less mountainous. The cultivable land is small, but the supply of water is abundant. The average range of the thermometer is from 43° to 89° in the city of Victoria; but it is much cooler on the range of hills above, where many of the principal inhabitants possess summer residences. On the whole it may be said that Victoria in Hong-Kong has the summer of Alexandria and the winter of Naples.

There is a good anchorage at Hong-Kong Roads and Victoria Harbour, which are both near the town of Victoria. Hong-Kong as a British colony on Chinese soil is most important in its political and defensive position, and is the headquarters of the military, naval, and mercantile establishments. The harbour is at once one of the finest and one of the most beautiful in the world, possessing a sheltered area of 10 square miles, while many features of the surrounding scenery recall the Gulf of Spezzia. The city of Victoria extends for more than 4 miles along the south shore of the harbour, and contains about 700 houses of stone and brick, many of them spacious and handsome. The chief streets are shaded with trees. There are several newspapers printed in the English language, and one three times a week in Chinese. Regular steam communication is kept up with England, India, Manilla, Canton, Macao, Shanghai, and all the northern ports. Owing to the barrenness of the soil the industries and manufactures are not very important, the principal being rum distilling, sugar refining, and ice-making. There are no port charges or dues levied on goods or ships entering the harbour, so that vessels may discharge, load, or tranship without any customs' officer, and the tonnage of the vessels which now annually enter and clear from the island is over 5,000,000, or more than was entered at the port of London in 1842—the year in which Hong-Kong was annexed to the British crown.

The annual revenue of Hong-Kong averages about £250,000. As Hong-Kong is a free port it is impossible to obtain accurate statistics of the imports and exports, but the great value of the trade connected with it may be estimated from the amount of shipping. In fact, Hong-Kong is the

centre of Eastern commerce in many kinds of European, Asiatic, and American goods, and the transactions of the trade in silk and tea are mainly controlled by the mercantile firms of which the headquarters are fixed in this great emporium. Hong-Kong is already well provided with the establishments required by its vast commerce. There are five docks, provided with all the appliances necessary for the repair of ships of war and merchant vessels. There is communication by steamer and telegraph with nearly all parts of the world. Telegrams of all important events occurring in Europe, Asia, and America appear within a few hours in the daily newspapers of Hong-Kong. Besides defraying the expenses of public works, police, port, shipping, and lighthouse, and other matters, the colony annually contributes £20,000 to the imperial funds for the support of the garrison. With all this it has been the regular boast of Hong-Kong that it is the only state or colony of importance which at the present day is not only without a public debt, but which possesses invested assets nearly equal to its annual revenue. Gas and water works have been established at Victoria, the capital, and numerous Chinese and European schools set up throughout the colony. The numerous roads are models of what roads should be, and owing to the fortuitous aid of successive conflagrations, the character of the dwelling-houses has become better and better until there are native streets in Hong-Kong that would do credit to any European city. The shore of the bay presents the appearance of a mass of solid masonry, while along the sea front is the Bowring Praya, a fine open thoroughfare like the Thames embankment. Considering the natural difficulties to be overcome, the improvements and prosperity brought about under English methods are extraordinary, and the effect on the native mind can hardly be overestimated. The European population is decreasing, but the number of Chinese is rapidly increasing, many of whom have mastered the technicalities of Western commerce and are able to conduct their foreign trade in their own name and without extraneous advice. Several steam lines are owned by Chinese merchants. Public companies for various other purposes, purely Chinese in constitution and management, are formed under the Colonial Limited Liability Act. Hong-Kong is the seat of a bishopric; and, in addition to the cathedral and the established churches, has places of worship for Roman Catholics and various dissenting denominations.

HON'ITON, a market-town of England, in the county of Devon, and formerly a parliamentary borough, is situated near the south-east bank of the river Otter, 17 miles E. by N. from Exeter and 154¾ from London by the South-western Railway. It stands in a vale famous for its beauty and fertility, and consists principally of one broad street crossed by another at a right angle. Through the former flows a small clear stream, which supplies the inhabitants with water. The houses are mostly modern, and the streets are well paved and lighted. Excellent pillow lace is still manufactured here, but by no means to so great an extent as formerly. There are also two breweries, brick, drain-pipe, and tile works, and an iron foundry. The chief buildings are two churches, several dissenting chapels, a good grammar-school, and a literary institute. The town returned two members to the House of Commons until 1867. It was then deprived of one, and in 1868 it formed one of the seven English boroughs which were totally disfranchised in order to provide additional members for Scotland. The population in 1881 was 3358. Honiton was granted by Henry I. to Richard de Rivers, from whom it descended to the Courtenays, earls of Devon, who for many years have been the patrons and lords of the manor. The lace which is known as "Honiton" is now chiefly made at Sidmouth.

HONOLU'LU, the chief town of the Sandwich Islands, Pacific Ocean, is a seaport in the island of Oahu, in lat. 21° 30′ N., and lon. 158° W. In 1884 the population was estimated at 18,000—many of them being naturalized subjects from the United States. It is an entrepôt for European and Indian goods; and sugar, coffee, hides, tallow, rice, wool, salt, whale-oil, pumpkins, melons, oranges, limes, &c., are exported. About 170 vessels, besides whalers, call here every year, the port having great advantages from its position in the Pacific. An English newspaper is published, and there is a theatre, hospital, music-hall, post-office, and government offices and legislative halls.

HONORA'RIUM, a recompense for the services of a counsel or physician, so called because the fees were presumed to be given beforehand and as a present or gift. Until recently neither counsel nor physician could recover their fees by legal process, but as the law now stands the latter can get a judgment for his fees by action. The old law remains in force with regard to counsel, and in the case of Kennedy *v.* Brown, 1863, it was decided that a counsel cannot validly make a special agreement for a fixed sum, nor recover against his client in default of payment.

HONO'RIUS was the name assumed by four popes.

Honorius I. (625–38) is remarkable to us as being a formally condemned heretic. He earnestly endeavoured to reconcile the Monophysite (Eutychian) heretics with the church by proposing to admit that God in the person of Christ had redeemed man by this one manifestation of his will. The Monophysites demanded the dogma of a single nature in Christ, instead of the twofold nature taught by the church, the co-existence of human and divine elements; and the patriarch Sergius of Constantinople, relying upon an epistle of one of his sainted predecessors, offered them in its stead an admission of *one will.* He was backed by the Emperor Heraclius, and finally by the pope (633). The *monothelite* (one will) heresy was thus sanctioned by all the great powers, temporal and spiritual, and the church seemed settled to receive it as doctrine. Heraclius issued an *Ekthesis*, or exposition of faith, declaring that the doctrine of two wills in Christ was a heresy (638). Both Sergius and Honorius died upon the appearance of the Ekthesis. In 681, at the Council of Constantinople, the West having again turned to orthodoxy and eventually converted the emperor of that day, Honorius was branded as a heretic, with the whole line of patriarchs of Constantinople since Sergius. The sentence was confirmed by the second Council of Nice, held in 787.

Honorius II. (Lambert of Ostia, not Peter Cadalus, 1061–64, the anti-pope who assumed the same title) reigned from 1124 to 1130. He had as legate assisted in drawing up the Concordat of Worms. The Knights Templars received papal sanction at his hands. Honorius was forced upon the church, which had already elected the virtuous Theobald as pope, by the powerful Frangipani family. Theobald retired, rather than cause a schism. Honorius prudently offered himself to the church for election after his enthronement.

Honorius III. (*Cencio Savelli*, 1216–27) followed the bold Innocent III., he whom King John of England had good cause to remember. The quarrel with the Emperor Frederick II. was still blazing, but Honorius, in a feeble attempt at peace, consented to crown the brilliant rebel against the church in 1220. It was only a feigned reconciliation; the mutual hatred between the papacy and the empire was fiercer than ever under the next pope, Gregory IX. Honorius is famous as the establisher of the two great orders of friars, and of many "tertiary" orders. The Dominicans received his sanction in 1216 and the Franciscans in 1223.

Honorius IV. (*Jacopo Savelli*) reigned 1285–87.

HONO'RIUS AUGUSTUS FLAVIUS, Roman Emperor, son of Theodosius the Great and younger brother of Arcadius, was born at Constantinople in 384. After

the death of his father in 395, Honorius had for his share the Empire of the West, under the guardianship of Stilichon, and resided at Milan. For several years after Stilichon was the real sovereign of the West, and gave his daughter Maria in marriage to Honorius. He also endeavoured to extend his sway over the territories of Arcadius in the East, under pretence of defending them against the Goths, and recovered the province of Africa, which had revolted. In the year 402 Alaric came a second time into Italy, when Stilichon hastily collected an army, with which he met Alaric at Pollentia, on the banks of the Tanaro, and obliged him to recross the Noric Alps. After this victory Honorius repaired to Rome with Stilichon, where they were both received with great applause. In the year 404 Honorius left Rome for Ravenna, which he made his residence, and the province in which Ravenna is situated assumed the name of Romania (Italian *Romagna*), which it still retains. In the following year Rhadagaisus (Ratagar) invaded Italy with a large force of barbarians, but he was defeated and put to death by Stilichon. In the next year the Vandals, the Alani, the Alemanni, and other barbarians crossed the Rhine, and invaded Gaul. A certain Constantine in Britain usurped the imperial power, and, having passed over into Gaul, established his dominion there, and was acknowledged by Honorius as his colleague. Stilichon now began to be suspected of having an understanding with the barbarians, and possibly aiming at the empire. He was therefore put to death by order of Honorius, in 408. His death was fatal to the empire. Alaric again invaded Italy, took Rome, and proclaimed the prefect Attalus emperor, but almost at once dethroned him in favour of Honorius again. The indecision and bad faith of Honorius brought Alaric again before Rome, which was plundered in 410. It was in this year that Honorius recalled the Roman legions from Britain and left the Britons defenceless against the English and Picts and Scots, who hovered in clouds of pirate ships off their shores. After Alaric's death his son Ataulphus married Placidia, sister of Honorius, and took possession of Spain. Honorius died at Ravenna, in August, 423, leaving no issue.

HONOUR, ACCEPTANCES FOR, are payments or acceptances given to save the honour of a third person whose bill is on the point of being dishonoured. The person so paying or accepting usually has an "act of honour" drawn up by a notary-public, which, after reciting the facts of the case and the protesting of the bill, sets forth that the person named accepts the said bill *supra protest* for the honour of the drawer, holding the drawer and all other persons responsible to him for the amount of the bill and all interest, damages, and expenses. Sometimes, to avoid the danger of there being no one at hand to accept for honour, in the case of a bill which is known to be liable to be dishonoured, one of the endorsers will oblige the drawer (or acceptor), by adding the words "to whom apply in case of need" after his signature. Should any irregularity occur this person can be at once applied to, and the honour of all the parties thus saved as well as considerable expense avoided.

HONOUR, COURT OF, in military matters, a term applied to a board of inquiry appointed to ascertain the degree of guilt attached to misconduct, and also to decide whether the individuals charged may or may not have been guilty of ignominious behaviour.

HONOURABLE, MOST HONOURABLE, and **RIGHT HONOURABLE** are titles given in the United Kingdom to peers, their families, and persons holding certain public situations. A marquis or marchioness is styled Most Honourable; peers, peeresses, younger sons of dukes and of marquises, and their wives, and all the daughters of dukes, marquises, and earls, are styled Right Honourable. The younger sons of earls and all the children of viscounts and barons have the title Honourable. The prefix Right Honourable is also bestowed on Privy Councillors, the lord mayors of London, York, and Dublin, the lord advocate of Scotland, and the lord provost of Edinburgh; maids of honour, lords of session, the supreme judges of England and Ireland, are entitled to be designated Honourable. Members of the House of Commons are, during debate, addressed as Honourable, but do not prefix the title to their names in ordinary usage. In America, nearly all persons taking prominent parts in public affairs are styled Honourable.

HONOURS OF WAR, a military term applied to the conditions under which a fort or city is evacuated. In some cases the retreating forces are allowed to depart with all their colours, baggage, artillery, &c.; in others they have to retire to a distance, pile their arms, and surrender as prisoners of war. *Military honours* are salutations paid to crowned heads or officers of rank by the discharge of artillery, drooping of colours, and other modes.

HOOD, ROBIN, a famous English outlaw whose exploits form the subject of many old ballads and traditionary stories, and who appears to have flourished some time during the thirteenth century. He was the most distinguished in his time of those outlawed men who under the tyrannical government of the early Norman kings lived in bands in most of the great forests, and combined a sort of championship of the cause of the old national independence with the practice of hunting the deer and of robbery. The first authentic mention of him is found in the poem entitled the "Vision of Piers the Plowman," dating from between 1355 and 1378, where reference is made to the "rymes of Robyn Hood." A poem entitled "The Lytel Geste of Robyn Hood" was printed by Wynkyn de Worde about 1495, and early in the sixteenth century it was customary in many places to celebrate his memory by a series of rustic sports and games. In the ballads relating to Robin Hood he is depicted as the bold and skilful leader of a band of reckless outlaws, all of whom were skilled in the use of the quarterstaff and the long bow. Under his rule the band spared the poor and distributed to them a share of the plunder obtained from the priests, the abbeys, and the rich landowners, while no woman was ever insulted or molested. To carry out his plans the outlaw assumes numerous disguises, and he frequently becomes involved in personal encounters, in which he is by no means always victorious.

The chief home of Robin Hood and his followers was the forest of Shirewood or Sherwood in Nottinghamshire, but he is said to have also frequented Barnsdale in Yorkshire, and Plumpton Park in Cumberland. His grave, marked by a flat stone, has for ages been pointed out in Kirklees Park, Yorkshire. Of his followers the most celebrated in the ballads are his lieutenant, a man of giant size and strength, facetiously termed Little John; his chaplain, a rollicking priest named Friar Tuck; and his mistress, Maid Marian. "The personal courage of this celebrated outlaw," Bishop Percy observes, "his skill in archery, his humanity, and especially his levelling principle of taking from the rich and giving to the poor, have in all ages rendered him the favourite of the common people." With regard to his actual position in history he has been variously described as a Saxon patriot waging war against the Normans, as a follower of Simon de Montfort, as the rightful but dispossessed heir to the earldom of Huntingdon, and lastly the Rev. Joseph Hunter, in a tract published in 1852, endeavours to identify him with one of the "porteurs" of King Edward II., called in the exchequer accounts Robyn Hood. Amid such a variety of conflicting statements it is difficult to arrive at any distinct facts relating to this celebrated personage, but there seems no reason to doubt his historic reality.

HOOD, SAMUEL, VISCOUNT, a celebrated English admiral, was born 12th December, 1724, at Butleigh in Somersetshire, of which parish his father was the incumbent. He was brought up to the navy, and was appointed in 1757 to command the *Antelope*, fifty guns, in which he took a French fifty-gun ship. In 1759, in the *Vestal*, thirty-two guns, he was again successful in capturing the *Bellona*, a French frigate of equal force. He served in the Mediterranean, under Sir Charles Saunders, till the end of the war in 1763, and was appointed to a command on the Boston station in 1768. In 1778 his services were rewarded with a baronetcy. In 1780 he was promoted to the rank of rear-admiral, and sailed with a squadron to the West Indies to join Sir George Rodney. By Rodney's departure to England, in 1781, Hood succeeded to the command of the fleet. After the action of 12th April, 1782, in which the French fleet in the West Indies, under the Comte de Grasse, was defeated by the British fleet under Admiral Rodney, who had again assumed the command on his return from England, Hood, who commanded a part of the fleet and greatly distinguished himself, was created an Irish peer by the title of Baron Hood of Catherington, and Rodney returned finally to England, leaving Lord Hood again in the chief command, which he retained till the peace of 1783. In 1784 (his Irish title being no bar to this honour) he was elected member of Parliament for Westminster, and became lord of the admiralty in 1788. In 1793 he was appointed to command the Mediterranean fleet, and took possession of Toulon, but being compelled to evacuate it by the republican army, he destroyed the arsenal and public stores as well as all the shipping he was unable to carry away. Early in 1794 Lord Hood applied himself to the expulsion of the French from Corsica, which was accomplished chiefly by the astonishing exertions of the British sailors on shore, especially in the capture of Bastia, for which Lord Hood received the thanks of both Houses of Parliament. His health being much impaired, he returned to England at the close of the year. In 1796 he was appointed governor of Greenwich Hospital, and raised to the English peerage by the title of Viscount Hood of Whitley. He afterwards received the Grand Cross of the Bath. He died at Bath in his ninety-second year, 27th June, 1816.

HOOD, THOMAS, poet and humorist, equally distinguished in both capacities, was born 23rd May, 1798, in the Poultry, London, where his father was a bookseller, of the firm of Vernor & Hood. In 1811 Hood's father died, and his mother sent him to a day-school. From this school he was removed to the counting-house of Messrs. Bell & Co., Russia merchants, Warnford Court, City, but his health soon began to fail, and he was sent to Dundee, where he contributed some humorous and poetical articles to the local journals. After a residence of two years, he returned to London, and engaged himself to his uncle Mr. Robert Sands, an engraver, in order to learn his art, and was afterwards with Le Keux for the same purpose.

In 1821 he succeeded Mr. John Scott as editor of the *London Magazine.* His first publication in a separate form was "Odes and Addresses to Great People," in which he was assisted by his brother-in-law, J. H. Reynolds, and which was brought out anonymously. "Whims and Oddities," published in 1826, in small 8vo, consisted chiefly of his contributions to the *London Magazine*, with some additions. His next work was in prose, "National Tales," which was followed by "The Plea of the Midsummer Fairies, Hero and Leander, Lycus the Centaur, and other Poems."

He commenced the *Comic Annual* in 1829, and continued it for nine years. In the same year his comic poem of "The Epping Hunt" came out. He was for one year editor of *The Gem*, and wrote for it his poem called "Eugene Aram's Dream."

In the spring of 1834 Hood became the occupier of Lake House, near Wanstead, in Essex. While residing here he wrote his novel of "Tylney Hall," but pecuniary difficulties compelled him to leave his pleasant residence in 1835. The *Comic Annual* having terminated in 1837, Hood commenced the publication of "Hood's Own," in a series of monthly numbers. He afterwards went to the Continent for the benefit of his health, and in Belgium he published his "Up the Rhine." On his return he became editor of the *New Monthly Magazine;* after his retirement in 1843 he collected his contributions to that work, and, with additions of prose and poetry, published them under the title of "Whimsicalities."

In 1844 Hood started his last periodical, *Hood's Magazine*, and continued to supply the best of its contributions till within about a month before his death. Those who have read the work, and have a taste for wit, humour, and character, will not readily forget his "Schoolmistress Abroad" and his novel of "Our Family," which was interrupted by his last illness and death: the closing chapters were in fact written when he was propped up by pillows in bed. Hood was an occasional contributor to *Punch*, and it was in that periodical his immortal "Song of the Shirt" first appeared. He had the consolation, a short time before his death, of having a government pension of £100 a year offered to him by Sir Robert Peel, which was transferred at his own request to his wife. He died 3rd May, 1845, and was buried in Kensal Green Cemetery. An appropriate monument, raised by public subscription, is erected there to his memory. As a writer Hood possessed great versatility of talent. An acknowledged master of the grotesque and ridiculous, a prince of punsters, and possessed of an indomitable humour which no distress or suffering could quench, it is yet as a serious poet that he will be longest remembered. In the "Song of the Shirt," "The Bridge of Sighs," and the "Lay of the Labourer," he struck out for himself a new path in poetry, and though there have been many since who have followed in his steps, his poems still remain unsurpassed in the tenderness of their sympathy and the beauty of their construction. His complete works, with a memoir, were published in 1869–73, under the editorship of his son Thomas Hood.

THOMAS HOOD the younger, who inherited much of the spirit of his father, was born at Wanstead, 19th January, 1835. He was the author of several novels and a number of amusing books for children, and in 1865 he became editor of *Fun*, a post which he sustained with great success for several years. He died 20th November, 1874.

HOOG'LY or **HUG'LI RIVER** is the most westerly and, for commercial purposes, the most important channel by which the Ganges enters the Bay of Bengal. It takes its distinctive name near the town of Santipur, a little above the point where the waters of the Bhagirathi join those of the Matabhanga, at a distance of about 120 miles from the sea.

Roughly speaking, the Hoogly may be divided into two sections—(1) a short one of about 40 miles, from the point near Santipur, where it takes its name, to Calcutta; and (2) a longer section of about 80 miles, from Calcutta to the sea. During the first section of its course its channels are under no supervision. The result is that they have silted up, and shifted to such an extent as to be no longer navigable for sea-going ships.

The history of the Hoogly from Calcutta downwards presents the converse of this narrative of ruin and decay. Not only has there been no deterioration, but the 80 miles of waterway between Calcutta and the sea have immensely improved under English supervision. Yet on this lower section lies one of the most difficult problems which river engineering has ever been called upon to solve. The James and Mary Sands, 30 miles below Calcutta, used to be reckoned so perilous that until well into the present

century East Indiamen lay at Diamond Harbour, just below their dangerous currents. A minute supervision of the channels, with steady dredging and a constant readjustment of the buoys, now renders the Hoogly a safe waterway to Calcutta for ships of the largest modern tonnage, drawing up to 26 feet. Much attention has been paid to the port of Calcutta itself. Its channels are kept clear by steam dredgers, and a line of jetties with steam cranes affords the latest modern facilities for the discharge of cargo. The Hoogly is crossed at Calcutta by a floating bridge, with a movable section which allows the smaller vessels (principally native craft) to pass upwards.

Estuary of the Hoogly.—Shortly after the river leaves Diamond Harbour, 41 miles below Calcutta, it widens out; and at Kalpi (Culpee), on its left or eastern bank, 48 miles from Calcutta, the estuary may be said to commence. At Khijiri (Kedgeree), 68 miles from Calcutta, on the right or western bank, it becomes a vast sea, with the low-lying Midnapur coast on the west, and Sagar (Saugor) Island, just rising a few inches above the level of the sea, 15 miles distant, on the eastern side. Sagar or Middelton Point is passed at 83½ miles below Calcutta, and the Sagar anchoring buoy at 86. For practical purposes, the sea may be said to commence at about 80 miles from Calcutta, but the outer floating light lies 121¾ miles, and the outermost or south channel buoy 131¾ miles. The estuary of the Hoogly is famous for its sandbanks, which are subject to great and rapid changes.

The tide runs rapidly in the Hoogly, and produces a remarkable example of the fluvial phenomenon known as a "bore." It is felt as high up as Calcutta, and frequently sinks small boats or dashes them to pieces on the bank.

The scenery on the banks of the Hoogly varies greatly. The sea approach is disappointing. For many miles nothing but sandbanks can be seen. These are succeeded by mean-looking mud formations covered with coarse grass, and raised only a few inches above high tide. By degrees cocoa-nut trees seem to stand out of the water on the horizon. As the river narrows above the James and Mary Sands, however, the country is not so low, and grows richer. Trees, rice-fields, and villages become common, and at length a section is reached where the banks are high and lined with hamlets buried under evergreen groves. The palm foliage and feathery bamboos assert themselves more and more strongly, and give a luxuriant tropical type to the landscape. When at length the limits of the port are reached, a scene of unexpected magnificence, unrivalled in its kind, bursts upon the eye. The long tiers of shipping, with the stately painted mansions of Garden Reach on the margin in the foreground, the fort rising from the great plain (*maidan*) on the bank higher up, and the domes, steeples, and noble public buildings of Calcutta beyond, gradually unfold their beauties in a long panorama. The traveller really feels that he is approaching a city of palaces. The river by which he has reached the capital furnishes, as already mentioned, one of the greatest triumphs of engineering skill.

HOOK, THEODORE EDWARD, was born 22nd September, 1788, in Charlotte Street, Bedford Square, London. He was the son of James Hook, a musical composer of some celebrity, by his first wife (Miss Madden). His father was employed at Vauxhall and the theatres, and Theodore wrote songs for him, and sometimes composed the airs. In 1805 he wrote an operatic farce, "The Soldier's Return," which was very successful. He afterwards wrote several other successful operatic pieces and farces.

Hook was even at this period distinguished for his conversational powers, but his talent as an *improvisatore* is described as extraordinary. He was invited to perform before the prince regent, who was so much delighted that in 1812 he got him appointed accountant-general and treasurer to the colony of the Mauritius, with a salary and allowances amounting to nearly £2000 a year. He reached his destination 9th October, 1813. In 1817 a large deficiency in the assets of the office was discovered, an investigation took place, and Hook was arrested on the 9th of March, 1818; all his property was seized, and he was sent back to England in custody. The peculation was ultimately found to be the work of his deputy, but for this he was held responsible, and the result of an examination of the matter by the law-officers of the crown was a claim upon him for £12,000.

The *John Bull* newspaper was established soon after Hook's return, and he became the editor. Hook, in its prosperous state, received full £2000 a year from it; and, though its circulation gradually diminished, he derived a considerable profit from it up to the time of his death. In August, 1823, Hook was arrested under a writ of exchequer; his property was sold, and realized about £40; and he was taken to a sponging-house, where he remained till April, 1824, whence he was transferred to the King's Bench, where he remained till May, 1825, when he was released.

Hook published his first series of "Sayings and Doings" in February, 1824, while confined in the sponging-house, and his diary records the profit to have been £2000; and he realized sums almost as large by the novels and other works which he published in rapid succession afterwards. The more important of these were "Maxwell," 1830; "Love and Pride," 1833; "Gilbert Gurney," a novel which contains much of his own autobiography, 1835; "Jack Brag," 1837; "Gurney Married," 1839; and "Peregrine Bunce," which was published after his death in 1842.

After his release from imprisonment, in 1827, he took a house in Cleveland Row, St. James'; he became a member of divers first-rate clubs, received invitations from persons of the highest distinction, and ran himself rapidly and deeply into debt, notwithstanding the large sums which he obtained by his literary labours. By his extravagance, which he supplied at a ruinous expense of labour of mind and body, his constitution was completely broken up. He died 24th August, 1841, in the fifty-third year of his age.

HOO'KAH, an Eastern tobacco-pipe, the stem or tube of which in the cheap form is made of a cocoa-nut, while some ornamental tubing lengthens it out into several coils. In pipes of better quality the mouth-piece is usually of amber; the bowl of shell, silver, or earthenware; and the smoke passes through a glass water-vase. These hookahs are in almost universal use among the upper classes of the Arabs, Turks, Indians, Egyptians, and other Oriental nations; and on all occasions of friendly visits they are considered as the calumets of peace.

HOOKER, RICHARD, an illustrious English theologian and prose writer, was born at Heavitree, near Exeter, about 1553 or 1554. His parents, though of good family, were in straitened circumstances, but the abilities displayed by Richard while at school gained for him the patronage of Bishop Jewel, who procured for him in 1567 a clerkship in Corpus Christi College, Oxford. In December, 1573, he became a scholar of that college, a fellow and master of arts in 1577, and in 1579 he was appointed lecturer on Hebrew in the university. He took orders about 1581, and soon after was appointed to preach at St. Paul's Cross, London. During his visit to the metropolis, he stayed at the house of a Mrs. Churchman, whose daughter Joan he married the following year—the marriage proving to be a very unhappy one. After this event he settled in the living of Drayton Beauchamp, in Buckinghamshire. In 1585, through the influence of the Archbishop of York, he was appointed master of the Temple, where he soon became involved in a controversy with Travers, the afternoon lecturer at the same church, Hooker upholding Episcopacy and Travers Presbyterianism. This controversy

suggested to Hooker the outline of his great work, and in order that he might have leisure to elaborate it, he obtained from the archbishop the living of Boscombe in Wiltshire, where he removed in 1591, being made a prebend of Salisbury the same year. Here he completed the first four books of his "Ecclesiastical Polity," which were published in 1594. In 1595 he was presented to the living of Bishopsbourne, in Kent, which he held till his death, 2nd November, 1600. The fifth book of his great work was issued in 1597, but the sixth and eighth were not published until 1648, and the seventh not until 1662. Of these posthumous volumes the seventh and eighth books are regarded as being substantially his composition, but the sixth book is considered to be a forgery by some unknown writer, though possibly some of the matter may have been derived from Hooker's manuscripts.

The "Ecclesiastical Polity" is a great monumental work, and it formed at the time of its publication an elaborate defense of the Church of England based upon philosophical grounds. It is marked by great profundity and comprehensiveness of thought, a wealth of learning, strong feeling restrained by a calm tranquil habit of mind, and it is composed in a style of rich and solemn eloquence. Hooker was one of the first to develop the resources of his native tongue and to prove its fulness, expressiveness, and beauty. The sweep and cadence of his sentences are in felicitous union with the march and majesty of the thought and imagery. His life was written by Izaak Walton, and was prefixed to the second edition of his works in 1662, and a biography was also prefixed to Keble's edition of Hooker's works (four vols., London, 1836).

An honourable epithet has firmly attached itself to Hooker. He is the "*judicious* Hooker." The title is said to have come from Queen Elizabeth, who admired Hooker greatly; as also did the pope, Clement VIII.

HOOKS and EYES, for fastening ladies' and children's dresses, are made entirely by machinery. One machine will manufacture 100 hooks and eyes in a minute.

HOO'LOCK (*Hylobates hoolock*) is a species of GIBBON found in Assam, among the Garrow and Cossiah hills. It is one of the largest species of gibbons, measuring when full grown nearly 3 feet, and is covered with harsh, shining, black hair, with a broad white or grayish band across the forehead above the eyebrows. The food of these gibbons consists principally of fruits, but they also eat some kinds of grass and the young shoots and leaves of the peepul and other trees, which they chew, swallowing the juice, and then rejecting the indigestible part. They are said to go in herds of from 100 to 150 individuals, raising a howling noise, which may be heard at a great distance. According to Dr. Burrough, who kept one of these apes in confinement, the hoolocks walk erect with great ease, balancing themselves by raising their arms above their heads; but if urged to greater speed they drop their hands to the ground, and assist themselves forward, jumping rather than running. If they succeed in making their way to a grove of trees, they swing with such astonishing rapidity from branch to branch and from tree to tree, that they are soon lost in the forest. In confinement they are gentle and tractable, and appear to entertain some affection for their master.

HOO'NUMAN (*Semnopithecus entellus*) is a monkey of the genus SEMNOPITHECUS or Sacred Monkeys. The hoonuman is the most sacred of sacred monkeys among the Hindus, partly owing to the Brahmanical doctrine of metempsychosis, but probably still more on account of its supposed derivation from one of the personages of their mythical history. In the great epic poem of the "Ramayana," which is devoted to the exploits of Rama, an incarnation of Vishnu, that hero contracts an alliance with Hoonuman, king of the monkeys, in his war with the Rackshasas of Ceylon. Throughout the war Hoonuman plays the principal part next to Rama himself; but having stolen a mango-tree from a garden in Ceylon for the purpose of giving it to the Hindus, he was condemned to have his face and hands blackened, a mark of disgrace which his descendants continue to bear to the present day. According to another account, Hoonuman was condemned to be burned by the giant from whom he stole the mango, but escaped with no greater injury than the singeing of his face and hands. We learn also that Hoonuman endeavoured to set Ceylon on fire by means of a lighted tar-barrel tied to his tail; but finding unexpectedly that the latter appendage was not fire-proof, he hastened to the Himalayas and dipped it into a lake at the source of the Ganges, which bears the name of Bhunderpouch or "monkey's tail" to this day. The Hindus believe that every year a single monkey is sent by his fellows to take his station on the snowy peak of a mountain which rises from the sacred lake, and there keep watch until he is relieved from his severe duty in the following season.

These monkeys being protected from all injury by the superstitious veneration of the natives, become so abundant in certain districts as to be a positive nuisance. They often descend in troops upon cultivated grounds, and will strip a maize field of moderate size in a few hours. Fortunately the tiger has no conscientious objection to the hoonuman's flesh, and the great carnivore destroys many of these monkeys. The hoonuman is confined to the right banks of the Ganges and the Hoogly. It is a large monkey—the old males measuring nearly 5 feet in height—of a yellowish or grayish-white colour, darker on the back, limbs, and tail, and with the face and hands black. The hair above the eyebrows forms a sort of projecting fillet across the front of the head; the face is bordered on each side with light whiskers, and the chin is furnished with a beard, which is peaked and directed forwards. As the animals increase in age the fur becomes darker, until it is of a nearly uniform rusty-brown colour.

HOOPER, JOHN, one of the most venerated martyrs of the Reformation, was born in Somersetshire about 1495, and educated at Merton College, Oxford. In 1550 he was appointed Bishop of Gloucester; but his assumption of the office was long delayed by his scrupulousness as to the use of the episcopal dress. By way of overcoming his reluctance, he was confined to his house, and finally committed to the Fleet Prison. His friends exhorted him to compliance, and at length the matter was compromised. In 1552, on the suppression of the see of Gloucester, he received the bishopric of Worcester *in commendam*. Wood says, "When Queen Mary began to reign, in July, 1553, he was pursuivanted up to London, in the latter end of August, and committed to the Fleet, where, remaining some months, he was at length examined several times, and required to recant his opinions, but standing constant and resolute to them, was condemned to be burnt." He suffered 9th February, 1555, at Gloucester, bearing his torments with great courage. He was the author of numerous controversial treatises, which, with many of his sermons, were published by the Parker Society in 1843 and 1852.

HOOPING or WHOOPING COUGH. This disease, to which on account of the violence of the cough that attends it the Latin term *Pertussis* has been applied, is also popularly called *Chin* or *Kink Cough*. It commences with the symptoms of simple catarrh, and is indicated by cough and the expectoration of a clear limpid fluid, by redness of the conjunctivæ, a watery discharge from the eyes and nostrils, hoarseness, and occasional sneezing. These symptoms are attended by some degree of fever, which in general, however, is very slight; the patient is languid and out of spirits, but is free from pain, or complains only of soreness in the anterior part of the chest. At the end of a period varying from one to two weeks, the fits of coughing become longer and more frequent; each fit is commonly announced by a sensation of tickling in the larynx and

trachea, during which the inspirations are irregular and incomplete, especially in children, whose countenances are at this time expressive of fear and anxiety. At the moment the fit comes on they cling with firmness to the persons or objects around them; if asleep at the time of its accession, they suddenly start up and place themselves in a sitting posture. The efforts of coughing are now repeated in such quick succession as to suspend almost completely the act of breathing. During their brief intervals we can with difficulty perceive any inspiratory movements, excepting at times when the cough is momentarily interrupted by a prolonged inspiration attended by a peculiar whooping noise, which has supplied a name for the affection, and which constitutes its characteristic symptom. In consequence of the obstruction to the circulation occasioned by these long-continued efforts of coughing, the face and neck become swelled and of a deep red or violet colour; the veins on these parts are distended almost to bursting, the eyes are prominent and bathed in tears; occasionally the patient becomes completely exhausted, and the fit of coughing is interrupted for one or more minutes; it then recurs with the same violence, and the patient seems in imminent danger of suffocation, when the paroxysm is terminated by one or two long and whooping inspirations, and by the rejection of a limpid viscid fluid, which hangs in threads from the mouth. This fluid comes from the bronchi and pharynx, and sometimes also from the stomach; it is occasionally mixed with particles of blood. These paroxysms or fits of coughing continue for many minutes, and when they are very severe blood frequently issues from the nose, mouth, ears, or even from the eyelids; they recur at various and often very short intervals, generally, however, more frequently and with greater severity by night than by day, and they are excited by the slightest causes, as by food or exercise, by any agitation or mental emotion. In the intervals of the fits the child appears to have its ordinary health.

After the affection has presented the characters which we have described for a period which varies from two or three weeks to as many months, the paroxysms become shorter and less frequent, and the cough ceases to be characteristic, but still continues to terminate in vomiting and the discharge of sputa, which now resemble those of catarrh. The paroxysms become more and more rare, in some cases recur at regular intervals, and finally cease, but for some time afterwards they are easily renewed by any unusual exposure to cold.

Hooping-cough is most common in spring and autumn; it prevails epidemically, and chiefly attacks children from birth to the period of second dentition. The mortality from it and from the complications by which it is attended is considerable, forming nearly 2½ per cent. of yearly deaths from all causes. Three-fourths of the deaths from it are of children under two years of age, and it is more fatal to girls than boys. It rarely affects the same individual more than once, although this sometimes happens; and though children are most liable, it occasionally occurs in adults, and even in old age. It is a highly infectious disease, its germs being frequently carried from house to house by the clothes of visitors. These germs, which are probably some form of a minute vegetable parasite or bacteria, are developed in large numbers during the progress of the disease, and are ejected in the mucus or phlegm which follows a fit of coughing; thus any morsel of mucus thrown off may be a source of infection to others. There is no specific known for hooping-cough, nor has any method of treatment been discovered by which its progress can be arrested. In mild cases little is necessary beyond attention to the general health, the avoidance of all indigestible articles of diet and anything that tends to undue excitement, and the keeping of the patient warm. In more severe cases the administration of mild emetics, gentle counter-irritation of the back and chest, and the use of sedatives, such as the bromides of potassium or ammonium, chloral, belladonna, &c., are of value, while in the later stages tonic medicines may be required. Of course such medicines can only be administered under medical advice, and in regard to the circumstances of each individual case. In the convalescent period a change of air will often bring the disease quickly to a close when other treatment has failed.

HOOP'OE (Upupidæ) is a family of birds belonging to the order VOLITORES. In this family the bill is long and slender, gently curved throughout its length, and acute at the tip; the small nostrils are placed close to the base of the bill; the wings are rather short and rounded; the legs are equally adapted for running and perching; the tarsi are short and stout, and terminated by three long and strong toes, armed with curved claws of considerable size. These birds are peculiar to the eastern hemisphere.

The Common Hoopoe (*Upupa epops*) is a well-known bird during the summer throughout the continent of Europe; the winter is spent in tropical Asia and Africa. It is a rare bird in our island; for though it has been known to breed in some counties, yet it is generally in autumn that stragglers on their southern migration make their appearance. This bird is the *epops* of the Greeks, and the *upupa* of the Romans. The hoopoe is about the size of a thrush, but distinguished from it by its handsome crest of cinnamon-coloured feathers of unequal lengths, having a white bar and black tips, which it can depress or elevate at pleasure. Its wings and tail are black, the former crossed by five white bars, the latter marked in the middle by a white crescent. Its general colour is a pale rusty brown. It derives its name from its incessant cry, which resembles *hoop, hoop, hoop*. The hoopoes are generally met with in woods in the vicinity of marshes, where they seek their food, which consists of worms and insects. They walk and run upon the ground with great ease when thus engaged. On the Bordeaux side of the Garonne, and near the city, are large spaces of marshy ground, intersected by broad ditches and creeks terminating in the river, where poplars and willows are planted for the sake of their twigs, used for tying the vines. These trees being lopped become very thick, and as they decay at the centre in a few years, are attacked by numerous insects, particularly the *Formica fuliginosa*. Here the hoopoes are frequently seen examining the rotten wood, and feeding on the insects which abound therein. The hoopoe flies low and seldom, unless disturbed, its food being so abundant as to require but little search. It breeds in a hole in a tree or wall about the end of May, the young coming out in June. The nests are made of a few dried grass-stalks and feathers; the eggs range from four to seven in number, of a pale lavender gray, about 1½ inch long and 8 lines broad. The nests are very offensive and unsanitary. Four other species of the genus Upupa are established, two from India and China, one from South Africa, and the fourth peculiar to Madagascar.

The Wood-hoopoes (Irrisor) are nearly allied to the true hoopoes. Numerous species are found in Africa, all remarkable for their brilliant metallic plumage and long tails composed of graduated feathers. The Red-billed Wood-hoopoe (*Irrisor erythorhynchus*) is a splendid bird, about 17 inches in length, of which the tail measures 10. Its plumage is varied with metallic green and blue; the wings and tail are spotted with white, and the bill and feet bright coral red. These birds inhabit the tall trees, where they creep along the branches in search of the insects and larvæ which constitute their principal nourishment. They are also said to feed upon figs. The voice is loud and very harsh.

HOORN, a city and fortified seaport of North Holland, on the Zuider Zee, eastward of Alkmaar, with which it is connected by a canal. It is a decaying town, but is well

built, surrounded by ramparts, and has 10,000 inhabitants. The great fleet of Admiral de Ruyter was built in Hoorn. There is still an active trade, chiefly in exports of butter, cheese, provisions, and fish. The manufactures of woollen stuffs, carpets, &c., shipbuilding, and the herring fishery, though still important, are insignificant compared with their former magnitude. Schouten, who first doubled Cape Hoorn or Horn, in 1616, and named it after his native place, and Tasman, the discoverer of Tasmania and New Zealand, were born at Hoorn. The large nets used in the herring fishery were first constructed here.

HOP (*Humulus lupulus*) is a perennial plant belonging to the same order, URTICACEÆ, as the nettle. It is a coarse twiner, inhabiting hedges in many parts of Europe and Western Asia to the Altai Mountains; it is also found in the United States, but has probably been introduced there. The stem is long and twining. The flowers contain only stamens or only pistils, and these are found on separate plants. The female flower consists of an ovary with two styles and a cup-shaped calyx; each is subtended by a small bract, and two occur together at the base of a large bract. These bracts are arranged spirally round a stalk, so as to form a kind of cone. Both large and small bracts enlarge as the ovary ripens into the fruit. The ripe fruit is about the size of a mustard seed. Minute yellow grains are found at the base of the bracts and on the ovary. This powder is the valuable part of the hop, and is called lupuline; it contains a volatile oil and a bitter principle. The superiority of the hop as an ingredient in our malt liquors depends upon the fact of its containing within itself several distinct and independent elements of activity, which the bitter herbs that have at different times been employed as a substitute do not possess. The bitter principle imparts to the beverage a tonic quality and an agreeable flavour; while at the same time an aromatic ingredient adds a warmth and stimulating property, and modifies the bitterness; it likewise contains an astringent principle (*humulotannic acid*, existing in the bracts), the effects of which are to precipitate the vegetable mucilage, and thus to remove from the beer the active principle of its fermentation. Every attempt, therefore, to substitute an ordinary bitter for that of the hop must necessarily fail unless a compound can be so artfully constructed as to contain in due proportions the principles of bitterness, astringency, and aroma.

The aromatic bitter gives to the hop a very marked power over the digestive organs when debilitated. A narcotic property exists in the oil of hops, so that tincture of hops, and even extract of hops, possess sedative powers, and often secure quiet and sleep where opium cannot be borne. Decoction does not seem to be a judicious mode of preparation, and should not be practised. Lupuline has been administered alone, but this does not possess any advantage over the tincture.

Hops were introduced into England from Flanders about the year 1524. The most extensive plantations are in Kent, Sussex, and Herefordshire, but they are also cultivated in Worcestershire, Wiltshire, Hampshire, Gloucestershire, Surrey, and several other counties. The hops of Kent and Sussex are the finest in the world. The hop requires a very rich mellow soil and careful cultivation. The soil of a hop garden must be rich to a considerable depth, or made so artificially.

The young plants are raised in beds, and may be raised from seed; but it is more usual to plant the young shoots which rise from the bottom of the stems of old plants. The varieties most esteemed are the Canterbury and Farnham goldings, the grape, and Farnham white bine. The young plants are placed in groups of three, about 6 inches apart, in the midst of prepared masses of soil about 2 feet asunder. A watering with liquid manure greatly assists their taking root, and they soon begin to show bines. A stick 3 or 4 feet long is then stuck in the middle of the three plants, and the bines are tied to this stick with twine or the shreds of Russia mats, till they lay hold and twine round it. During their growth the ground is well hoed and forked up around the roots, and some of the fine mould is thrown around the stems. In favourable seasons a few hops may be picked from these young plants in the autumn, but in general there is nothing the first year. Early in November the ground is carefully dug with the spade, and the earth being turned towards the plants, is left so all the winter.

In the second year, early in spring, the hillocks around the plants are opened and the roots examined. The last year's shoots are cut off within an inch of the main stem, and all the suckers quite close to it. A pole about 12 feet long is then firmly stuck into the ground near the plants; to this the bines are led and tied as they shoot, till they have taken hold of it. The ground being well hoed and the earth raised round the plants, the produce this year will average 4 cwts. per acre if the season is favourable. In September the hops assume a fine straw colour, turning to a brown; they are then in perfection, and no time should now be lost in picking them. The hops when picked are dried on a haircloth in a kiln. They are then laid in heaps on the floor, where they undergo a very slight heating. As soon as this is observed they are bagged. This is done by pressing them into large bags or pockets, suspended below a hole in the floor; when sewed close and tight the bag is stored in a dry place till the hops are wanted for sale.

The crop of the third year will average 8 cwts. per acre, and will in some cases reach 15 cwts.

As the hop is a diœcious plant—*i.e.* some of the individuals are male plants and others female—it is well to rear a number of the male plants among the others, or along the hedges of the hop-gardens, to insure the fertilization of all the seeds.

The poles are an expensive article; those of chestnut are the most durable, and also the dearest. They should be put into a shed during winter, or else be placed on end in the form of a cone, leaning against each other.

The uncertainty attending the culture of the hop is very great; the crop is most exhaustive of the soil, extracting as much nitrogen from an acre of land as 9 cwts. of guano will replace, and the hop-grower has to contend against a greater number of foes than perhaps any other cultivator. As the young shoots push themselves from the earth in March they are attacked by the hop-flea, a small beetle (*Haltica concinna*); and if the bines survive its assaults they are liable to destruction by the hop-fly or aphis (*Aphis humuli*). These assailants appear in May, and settling upon the plants, suck the under side of the leaves and deposit thereon their young, which possess the faculty of multiplying to an enormous extent. [See APHIDÆ.] If they are allowed to remain undisturbed they soon extract the juices of the bine; its leaves curl up, turn brown, and finally the bine drops from the pole. Nature has provided a check upon the multiplication of the aphides in the shape of the ladybird, the grub of which feeds upon them. The WIRE-WORM is another enemy to the hop-grower. It usually confines its unwelcome attentions to young grounds; but new and old plantations suffer from the depredations of various species of caterpillars (*e.g.* that of the GHOST-MOTH), and the destructive visitations of blight, mould, &c.

In 1884 there were 69,258 acres devoted to the cultivation of hops in England, of which 43,000 were in Kent, 10,000 in Sussex, 6600 in Hereford, and 3000 in Hampshire. Abroad the cultivation is carried on in Prussian Poland, North Germany, Bavaria, and Belgium, the entire continental crop being about equal to that of England. North America also produces a considerable quantity of hops, but of a coarse rank flavour.

The hop serves other purposes besides that of flavouring beer and being used medicinally. A brown dye is extracted from the young leaves; the bines have been converted into brown paper and made into cloth; the prunings are useful as winter provender for horses and cattle; in Belgium the young shoots are used as a vegetable in the way we use asparagus; and lastly, spent hops are useful as a manure.

Till 1862 hops used in England were liable to an excise and customs duty, which, on an average, yielded about £200,000 per annum to the revenue. But owing to the uncertainty attending the crop and other causes, in that year both duties were repealed, and a charge of 3*d.* per barrel on all beer brewed in the United Kingdom was substituted.

In 1883 the imports of hops into Great Britain amounted to 125,349 cwts.—value, £1,064,859—chiefly from Hamburg, Belgium, and the United States.

HOPE is vulgarly thought of as antithetic to fear; but a little consideration will show that courage is here the true antithesis. Our "hopes and fears" form a badly contrasted couple. Despair, not fear, is the truly hopeless state, but doubtless its having two syllables induced the popular ear to cast "despair" aside, and "fear" to gain a more correct rhythm, though at the price of a confusion of thought. Just as despair is an ideal conception, especially directed to the future, filled with profound disbelief, so also hope is readily analyzed into an ideal conception of a future, coupled with belief. This belief may be well-reasoned, or it may be merely an affair of temperament. It is the strength, and not the value, of the belief-element which makes the power or the feebleness of hope. It is manifest that unimaginative persons (often very absurdly called "practical" persons or "common-sense" persons, on the *lucus a non lucendo* principle, because they do less work and have less intelligence than the imaginative persons) can neither feel despair nor hope to any operative extent, because one element of hope, its ideal basis, is absent. On the other hand imaginative persons of a timid nature, or of feeble bodily health, are prone to occasional despair from not possessing the other element of hope, its firm belief, in sufficient measure.

The pleasure of hope, like all ideal pleasures, exceeds even the brightest reality.

> "Kings it makes gods, and meaner creatures kings."

In the first place, all disagreeable adjuncts are ignored with delightful ease, the companionship of the beloved one is to be enjoyed without the cares of matrimony, the high salary received without the exhausting pressure on the brain in the earning of it which more than neutralizes the power to enjoy, and so on in every case. The image, too, arises before us when we are fit to receive it. Actually we may reach a desired end when we are old or infirm, or suffering under some paralyzing blow, and the joys of success are as if they were not. But it is not in such states that we hope. Our most pleasing visions rise before us unbidden; they come when we are at ease, or when things are brightening out of gloom, or when we are young and strong and nothing is too difficult for us. The ideal seizes us at our best, picks its own time, decks itself also, as was just now said, in its gayest colours, setting aside every marring incident. What marvel is it that the prosaic actual, clad in every-day raiment and coming punctually to its time, whether that time is well or ill-chosen, falls at its best far short even of the quietest pleasures granted by its brilliant rival? Besides, our actual pleasures are but limited with the most fortunate among us, and very scanty with the large majority; but our ideal pleasures are scattered among us with a lavish hand, and their enjoyment is altogether unlimited. One dinner actually eaten satiates us, but in hope we can banquet at a thousand feasts without repletion.

No life is so happy as that of a hopeful virtuous man. If he is put about to-day, hope gilds to-morrow with all the brighter lustre of contrast. He cannot fail in the immediate prospect of such good things to be cheerful and good-humoured. His health may perhaps be alleged to endow him with hope, but while we must admit this, it is very certain, on the other hand, that hope always and unfailingly acts like a charm upon the health. Is one in pain? hope is the best anodyne. As Shakspeare says—

> "The miserable have no other medicine
> But only hopes."—"*Measure for Measure,*" iii. 1.

Another excellence must be claimed for this rainbow-hued emotion—or emotional state rather—namely, that it checks the too great self-concentred value we may put upon present affairs. Who cares much about hoarding his wealth that is very quickly to come into a large fortune? A man is inclined to be generous when he knows he is not compelled for prudence' sake to be sparing. After all it is generally an affair of temperament, and temperament is very largely an affair of health. A man of "sanguine temperament" is nine times out of ten a strong man, blessed with health and hope; a man of "bilious temperament" is too often an unhealthy man, a martyr to dyspepsia and despair. Would we enjoy the animating fairyland of hope, we must very often attend to the common humiliating details of diet and exercise. Addison, in one of his finest *Spectator* papers, very ingeniously uses hope (with memory) as an argument for the future life, "for," says he, "who can imagine that the existence of a creature is to be circumscribed by time whose thoughts are not?" As usual, however, it is Shakspeare who has hit the highest mark, and with one phrase has touched off the highest hope of all hopes, where he says, in "Richard II." (Act ii. scene 1):—

> "Even through the hollow eyes of death
> I spy life peering."

HOPE, THOMAS, was descended from the wealthy family of the Hopes of Amsterdam. He was born in London in 1770, and gave very early indications of his attachment to architecture. At the age of eighteen or nineteen he went abroad, and travelled for about eight years in various parts of Asia and Africa, as well as on the continent of Europe. Soon after his return to England he began to apply his studies practically by remodelling and enlarging his mansion in Duchess Street, Portland Place. He rendered his house one of the largest private mansions in the metropolis, and fitted up and furnished the interior in a style of classical taste that was then a novelty in this country. His publication on "Household Furniture," in 1805, created a revolution in taste. In 1809 appeared his "Costume of the Ancients;" and in the same year he contributed to a periodical entitled *Review of Publications of Art* an essay on the "Architecture of Theatres."

With the exception of a minor work, entitled "Modern Costumes," in 1812, Mr. Hope did not publish anything further till 1819, when appeared his "Anastasius, or Memoirs of a Modern Greek at the close of the Eighteenth Century"—one of the most remarkable novels of the time, and still read with great pleasure. The extensive travels of the author stood him in good stead. His last two works, both of them published posthumously, are, "The Origin and Prospects of Man," and an "Historical Essay on Architecture." Mr. Hope died on the 3rd of February, 1831.

HOPITAL, MICHEL DE L'. See L'Hopital.

HOP'LITES (Gr. *hoplitai*) were the main body of the Greek soldiers, the heavy armed infantry, from the earliest historical times down to the radical alterations of Alexander in organizing the Macedonian phalanx. The Spartan hoplites, all actual burgesses of the city and environs, were the flower of ancient Greek soldiery. Each one was not

only figuratively but literally a host in himself. for he had many helots and others to attend him; at Platæa, for instance, each Spartan hoplite had seven helots with him, serving as his spear-bearers and also as light armed troops. The whole body formed six divisions (*morai*) of about 500 each, and each mora had four *lochoi*, the lochos having also its squadrons of fifties, and the subdivisions of these being groups of oath-fellows. These latter were the military unit. They were men who had sworn a common oath, and always fighting shoulder to shoulder they gained a surprising confidence in each other.

The arms of the Spartan hoplite were helmet, cuirass, and greaves, a swordbelt over the left shoulder to carry the short straight sword, a long spear, or sometimes more than one, and a large round shield of brass, suspended by a thong to the neck and held by a handle or ring. The tunic beneath the armour was scarlet. Before a battle he dressed his hair and crowned himself as for a banquet. Then he marched forward to the music of flutes, not so much for the sake of a martial sound as to insure the exactness of keeping step, just as on parade.

HOR'ACE (QUINTUS HORATIUS FLACCUS) was born at Venusia, 8th December, B.C. 65. His father, who was a *libertinus*, or freedman, acquired some property (1 Sat. vi. 6, 86), with which he purchased a farm near Venusia, on the banks of the Aufidus. In this place Horace appears to have lived till his eleventh or twelfth year, when his father removed with him to Rome, where he was placed under the care of a celebrated schoolmaster, Orbilius Pupillus of Beneventum. After studying the ancient Latin poets (2 Epis. i. 70, 71) Horace learned the Greek language (2 Epis. ii. 41, 42). He also enjoyed during the course of his education the advice of his father, who was a sensible man, and is frequently mentioned by his son with the greatest respect. About the age of seventeen he went to Athens to pursue his studies (2 Epis. ii. 43–45), where he was when Brutus was raising troops to oppose Octavian and Mark Antony. He joined Brutus, was promoted to the rank of military tribune (1 Sat. vi. 48), and was present at the battle of Philippi, B.C. 42. Though the life of Horace was spared, his paternal property at Venusia was confiscated, and he repaired to Rome with the hope of obtaining a living by his literary exertions. In B.C. 41 he was saved from actual want by procuring employment as clerk to one of the quæstors. Some of his poems attracted the notice of Virgil and Varius. They introduced him to Mæcenas, whose liberality relieved the poet from all pecuniary anxieties.

From his introduction to Mæcenas till the time of his death, Horace appears to have enjoyed exemption from all cares; he was intimate with Virgil, Tibullus, and other distinguished literary men in Rome, and was a great favourite of his patron Mæcenas, and also of Augustus. He resided principally at Rome, or at his country-house in the Sabine valley, which had been given him by Mæcenas. He also had in the latter part of his life another country residence at Tibur (Tivoli). Horace died on the 27th November, B.C. 8, when he had nearly completed his fifty-seventh year.

The works of Horace have been printed by Mr. Tate, under the title of "Horatius Restitutus," in the order in which Bentley supposes that they were written (Cambridge, 1832). The Satires and Epistles, which are familiar moral discourses, most elegantly expressed, and full of wit and wisdom, are the most valuable of his works. The Odes, which are imitations of the Greek poets, are generally written in a very artificial manner. The best are those in which the poet describes the pleasures of a country life or touches on the beauties of nature, for which he had the most lively perception and the most exquisite relish; nor are his lyrical productions altogether without those touches which excite our warmer sympathies. The qualities in which Horace excels are good sense, judgment, and purity of taste. He is eminently the delight of accomplished men of the world. He is never very profound, but on the other hand he is always clever and bright, and dullness is not to be found in his pages. His "Art of Poetry" is a very fine performance. It was wonderfully imitated by Pope, in a poem which is almost as good as the original.

The following are the most esteemed editions of Horace:—Lambinus, 1561; Heinsius, 1629; Bentley, 1711; Burman, 1713; Sanadon, 1728; Mitscherlich, 1800; the edition of Baxter, edited by Gesner and Zeune, frequently printed; Doring, 1828–29; Braunhard, 1833; and Orelli, 1837–38 and 1843–44. Horace has been translated into almost all the European languages, both in prose and verse. An admirable translation of the odes, by Theodore Martin, appeared in 1860.

HORÆ CANONICÆ. See CANONICAL HOURS.

HO'RARY, in astronomy. The horary motion of the sun or a planet is the arc which it describes in one hour, or the angle which that arc subtends at the eye of the spectator.

HORA'TII and **CURA'TII,** two groups of three brothers of the Roman Horatian gens and the Alban Curatian tribe respectively, who, according to one of the most famous legends of Rome, met by agreement between the cities to decide the supremacy of one or the other of them by means of single combat. The fight was to be to the death. When the battle began it went heavily against the Romans, for two of the Horatii fell. The survivor, finding that the three Curatii were wounded badly, had the wit to separate them by making off as if in flight; then turning on his path he encountered all his foes separately, and had an easy victory.

In some versions the sister of the victor is said to be the lover of one of the slain Curatii, and to have so lamented the death of the enemy of her country as to provoke her brother, in the moment of victory, to such a point that he stabbed her. He was condemned to death, but released upon appeal, after undergoing formal penance for his crime.

HOR'DEÆ is a tribe of grasses, including our most useful cereals. It is characterized chiefly by the inflorescence. The spike is simple, except in cultivated varieties or abnormal growths; the rachis is notched and generally jointed; the spikelets, of one or more flowers, occur one or more together at each notch, collaterally sessile. The twelve genera belong to temperate regions and principally to the northern hemisphere; they may be arranged in three subtribes. The first subtribe, Triticeæ, contains Triticum (wheat), Secale (rye), Lolium (rye-grass), and Agropyrum; in it the spikelets have generally three or more flowers, and are singly sessile at each notch of the rachis. The second subtribe, Leptureæ, contains Lepturus, Nardus (nard or mat-grass), Psilurus, Kralikia, and Oropetium; it is characterized by the slender spikes and the spikelets solitary at the notches, each generally with only one flower. The third subtribe, Elymeæ, includes Elymus (lyme-grass), Hordeum (barley), and Asprella; in this subtribe the spikelets are two or more, collaterally sessile at each notch of the spike, or the lateral ones very shortly stalked. (See Bentham and Hooker's "Genera Plantarum.")

HOR'DEUM, the genus of plants to which barley belongs. As many as twelve species of Hordeum are recognized by Mr. Bentham, in addition to which there are many varieties. The species are found wild in various places in both the Old and New World.

Hordeum vulgare (common barley), with grains in four rows, is of very ancient cultivation, and its indigenous origin cannot be traced. Many of its varieties are also known to have occurred in very ancient times. [See BARLEY.] The following are those which are best known:—

Hordeum distichum is the common summer barley of England, and that which cultivators seem to prefer; its

ears are not so large as those of *Hordeum hexastichum*, but the grains are heavier. In this variety the lateral spikelets are generally abortive, and the grains appear in two rows.

Hordeum gymnodistichum (naked barley) is a variety but little cultivated now. The grain easily separates from the chaff.

Hordeum hexastichum is the bere, bigg, or winter barley of farmers, and is particularly valuable for ripening quicker than the common two-rowed barley, but its grains are lighter. To northern nations with short summers it is, however, invaluable. The grains are disposed in six rows.

Hordeum gymnohexastichum is extremely productive, and in some parts of Europe it is reckoned the most valuable of all. The French call it, on account of its good qualities, *orge céleste*.

Hordeum ægiceras "cannot be otherwise considered than as a luxuriant monstrosity" (Bentham). It is found in the northern parts of India, and probably in Tartary, as its grains have been sent to England under the name of Tartarian wheat. Its appearance is more that of wheat than of barley, and its naked grains assist the resemblance. Hordeum is distinguished from Elymus by the single flower in each spikelet. The wild species, *Hordeum sylvaticum*, *murinum*, and *pratense* are well known in England.

HORE'HOUND (*Marrubium vulgare*), a perennial herbaceous plant, a native of Britain, found growing by roadsides. It is bushy and about a foot high, its leaves being of a whitish woolly appearance, and possessing a faint odour, which becomes less by drying. It is a tonic stimulant, much used for the cure of coughs, being a very old-fashioned and excellent remedy. It is usually made into a syrup and mixed with sugar; sometimes candied into the form of rock. Other and finer species of horehound are found in various parts of Europe.

This genus belongs to the order LABIATÆ; the calyx is tubular; the upper lip of the corolla is flat, the lower is three-lobed; the stamens are inclosed within the tube of the corolla; the nuts are flatly truncate. Horehound, or as it is sometimes called White Horehound, from the dull-white flowers, is a native of Europe, North Africa, and North Asia. Black Horehound (*Ballota nigra*) is a fœtid plant, also belonging to the Labiatæ, with pale red-purple flowers. Water Horehound is *Lycopus europæus*.

HORI'ZON (Gr., bounding). The physical horizon is the apparent circle by which the spectator's view is bounded when he is upon a level and uninterrupted plain, such as the surface of a calm sea. It differs from the astronomical horizon in two points; first, because the physical horizon dips, as it is called, or is not at the same level as the eye; and secondly, because the astronomical horizon always supposes the spectator to be at the centre of the earth, and not at the surface. It is remarkable how difficult it is to fix the real distance of the visible horizon, as at sea, except by actual calculation. When the observer is on the deck of an ordinary Atlantic liner, that is, with his eye about 20 feet above the sea-level, the true distance of the horizon is over 6 miles; but it frequently looks nearer, and occasionally further off, by the mere testimony of the eye. Thus the astronomer Proctor, asking a sailor how far off he judged a passing vessel to be, was answered "Six or seven miles," though the ship was hull down (that is, was far enough beyond the horizon for her hull, probably standing some 12 feet out of the water, to be quite concealed), and therefore must have been in ordinary circumstances at least 11 miles off. In this instance circumstances very greatly aggravated this error, for the vessel from which the observation was taken had a saloon deck, and the eye was at least 30 feet above the water. The passing ship was thus at least $12\frac{1}{2}$ miles away.

The calculation is ingenious and simple. The geometrical calculation would give the dip of the horizon as 8 inches for 1 mile, 32 inches for 2 miles (8×2^2), 72 inches or 6 feet for 3 miles (8×3^2), &c. But the refraction of the atmosphere causes the horizon to recede, the eye sees along a descending curve, and the dip is only 6 inches for 1 mile. Carrying this onward we get 24 inches or 2 feet (6×2^2) for 2 miles, 54 inches or 4 feet 6 inches (6×3^2) for 3 miles, 96 inches or 8 feet (6×4^2) for 4 miles, 12 feet 6 inches for 5 miles (6×5^2), 18 feet for 6 miles (6×6^2), 24 feet 6 inches for 7 miles (6×7^2), and so on. The same holds good for distances beyond the horizon. Thus let the observer's eye be 24 feet 6 inches above the sea-level, and the horizon will be 7 miles away; let a ship whose hull is 12 feet 6 inches above the water be just hull down, and that ship will be 5 miles beyond the horizon, that is, 12 miles from an observer, situated as described.

The plane of the horizon at any place is perpendicular to the direction of a plumb-line, or parallel to the surface of any fluid at rest. At sea, when it is necessary to take the altitude of any heavenly body, the physical horizon is, in tolerably fair weather, sufficiently well defined for the purpose, and, with proper allowance for its dip, is used accordingly. But in land observations with a sextant or other instrument requiring a horizon, the surface of a fluid (generally mercury) is used, which is called an artificial horizon, but might more properly be termed an artificial portion of a horizontal plane.

HORI'ZON, in geology, is the term applied to a bed or assemblage of beds characterized by some distinctive fossil. Strata belong to the same geological horizon which have been formed at the same time, and which contain a similarity of fossil forms.

HORN. The structure of such horns as those of the ox, antelope, goat, and sheep may be described as a number of conical sheaths inserted one into another, the innermost of which lies upon the vascular membrane which covers the bony core. The tip, or that portion of the point of the horn which projects beyond the core, is very dense, and the several layers of which it is composed are scarcely distinguishable; while towards the base the layers may be readily distinguished, owing to their successive terminations forming prominent rings. Horn is an albumenoid substance, the chemical composition of which is shown in the article HORNY TISSUE; and there is a certain chain of connection between the substance of horns, nails, claws, hoofs, the plates of animals of the armadillo and tortoise kind, the scales of lizards, serpents, and fishes, hair, feathers, and even skin.

The principal kinds of horns employed in manufacturing operations are those of oxen, buffaloes, two or three species of deer, and sheep and goats. The first process is to remove the bony core or pith, which is accomplished by steeping the horns in water for several weeks, by which operation the membrane which lies between the core and the horny sheath is so destroyed or softened by putrefaction that the cores may be easily extracted. These are applied to many useful purposes. The solid tip of the horn is sawn off with a frame-saw, and is employed for making knife-handles, umbrella-handles, the tops of whips, buttons, and various other articles. The remainder of the horn, which is employed for purposes for which thin laminæ are required, may either be left entire or sawn into two or more lengths, according to the use to which it is to be applied. When divided, the lower part, or that next the root of the horn, is frequently employed for making combs, while the portion which has formed the middle of the horn is used for articles in which a thin plate of horn is required. To prepare the horn for use it is softened in boiling water; and, while hot from this operation, it is held in the flame of a fire until it acquires about the temperature of melting lead, and becomes so soft as to be semifluid. The slitting is performed while it is in the semifluid state by a strong pointed knife resembling a pruning-knife; and by the

application of two pairs of pincers, one to each edge of the slit, the cylinder or cone of horn is opened until it is nearly flat. Several such pieces are then exposed to pressure between alternate plates of iron until they are flattened. The thin sheets of horn are then scraped, rubbed down, and polished.

The various articles made of horn require manufacturing processes differing in various cases. Umbrella-handles, knife-handles, bell-pulls, drawer-knobs, &c., are made by softening the horn to such a degree that it may be pressed into moulds. Horn is easily dyed of various colours; but in this country it is usually coloured of a rich reddish-brown, and spotted to imitate tortoise-shell, by a mixture of pearl-ash, quicklime, and litharge, or red-lead, with water and a little pounded dragon's-blood. As already stated, when divided into thin plates horn is tolerably transparent, and was formerly used instead of glass in windows, in lanterns (hence called *lanthorns* by folk-etymology), and to cover school-books or manuscripts, &c., needing protection during use. See HORNBOOK.

No part of the refuse of the horn manufacture is without its value. When exposed to a decomposing heat in close vessels horn produces a large quantity of the gaseous compound which forms the base of prussic acid, on which account hoofs and horn cuttings are in great request among the manufacturers of Prussian blue and of the beautiful yellow prussiate of potash. The clippings of the comb-maker were formerly used as manure, but improvements in the manufacture have recently been made by which the smallest waste fragments may be united and made into a variety of articles. In France, too, a kind of artificial horn is manufactured from bones treated with muriatic acid, and converted into a horny substance by tanning and other processes.

HORN, a musical wind-instrument of very ancient origin, and of various forms. The *French horn*, or now, *par excellence*, the *horn*, is a tube of about 10 feet, very narrow at the top, but widening considerably at the bottom, and bent in rings for the convenience of the performer. It is not provided with holes, as the flute, &c.; and plays only in HARMONICS, the production of the various sounds depending upon the lips of the player, the greater or less pressure of his breath, and the insertion of the hand in the bell or wide end of the instrument. Crooks and shifting pieces are provided to adjust the instrument to different keys or fundamental notes. See FRENCH HORN.

The *bugle horn* is a tube of 3 feet 10 inches in length, doubled up in a small compass. The *keyed bugle*, or a bugle horn with keys, is that now in common use, the scale of which comprehends about two octaves, with the semitones. The CORNET-À-PISTON is an improved modern form of this instrument. See BUGLE.

The *Russian horn* is an unbent brass tube, conical in shape, of various dimensions; the deepest toned is 8 feet long and 9 inches in diameter at the wide end, and the highest is $2\frac{1}{2}$ inches in length by one at the wide end. The former gives A an octave below the first space in the bass, the latter gives e''' the third additional line above the treble. Some of these horns have keys, producing one or two semitones, but generally every note has its separate horn; and a band of Russian horns counts almost as many individuals as diatonic notes in a scale of between four and five octaves. By great practice the performers manage to execute tolerably rapid music. Their dexterity is akin to that of the HAND-BELL RINGERS.

Basset horn is the tenor clarionet. See CORNO DI BASSETTO.

The *English horn* is a deeper toned oboe, but of rather larger dimensions, somewhat bent, the lower end very open, and is to the latter what the basset horn is to the clarionet, or what the viola is to the violin. The tone of this instrument is extremely pathetic, and by the Italians is thought to resemble the human voice so much that they sometimes call it the *voce umana*. Its scale is from *a* below the treble stave, to $b\flat''$ above, or two octaves and a semitone. It is called also *Corno Inglese* or *Cor Anglais*.

M. Adolphe Sax excited much attention in the musical world, in the first half of the present century, by his *sax-horns* and *saxophones*. These instruments are a great improvement on those made in the old style, and have had a considerable influence on military music. See SAX-HORN, SAXOPHONE.

HORN'BEAM (Carpinus), a genus of trees belonging to the order CUPULIFERÆ. The word hornbeam was given to the tree on account of the horny texture of the wood. The botanical name is said to be connected with the Celtic *car*, wood, and *pin*, a head, as the wood was employed to make yokes for oxen; it is the Latin name for the hornbeam. Our word carpenter comes from the same root, through the Old French *carpentier* from the Latin *carpentarius*, a maker of *carpenta* or chariots. The hornbeam in Swedish is *karm*, in French *charme*. There are nine species, all deciduous trees, natives of Europe, Asia, and America.

The Common Hornbeam (*Carpinus Betulus*) is an indigenous British tree very common in copses, and frequently pollarded by the farmer. Loudon says:—"It is always found in cold, stiff, clayey, moist soils, where scarcely any other timber tree will grow; and in situations bleak, but seldom or never mountainous. . . . On chalk it will not thrive, in which respect it is directly the reverse of the beech." Its wood is coarse, and unfit for cabinetmaker's work, on account of the large size of its medullary processes and the undulating lines of the annual layers; but these circumstances render it inflexible, tough, and well suited for cogs, handles of tools, and for other purposes in which strength is required.

It makes excellent fuel. Evelyn says of it in this respect, "It makes good firewood, where it burns like a candle, and was of old so employed: 'Carpinus tædas fissa facesque dabit.'" On the Continent it is much used in this way, and especially in the form of charcoal; charcoal made of the hornbeam is preferred in the manufacture of gunpowder.

Although the hornbeam may grow to a height of over 50 feet, it is more adapted for training to act as screen-fences, as it can be cut and clipped. The leaves remain for some time after they have died in the autumn, so that the hornbeam becomes of great value in sheltering gardens and young plantations.

The Oriental Hornbeam (*Carpinus Duinensis*) is a native of Asia Minor and the Levant. It does not grow to a greater height than 10 or 12 feet, and is even better adapted than the common hornbeam for forming clipped hedges. The American Hornbeam (*Carpinus Caroliniana*) ranges in height between the above species.

In this genus the flowers are either male or female, and both kinds grow in catkins on the same tree. The male flower consists of six to twelve stamens in the axil of an ovate acute bract; the one-celled anthers are bearded at the tip. In the female catkins the outer bracts are deciduous; at the base of each there are two flowers, with a short style and two long thread-like stigmas. The fruit consists of a one-seeded nut inclosed by the large three-lobed bract. For hop-hornbeam see OSTRYA.

HORN'BILL (Bucerotidæ) is a family of birds of the order VOLITORES, characterized by the enormous and disproportionate development of their beak, and by the possession of certain cellular casques or processes surmounting the upper mandible. The bill is long, curved, and pointed, and the margins of the upper mandible are often irregularly toothed, as if small fragments had been broken out of them; the nostrils are placed at the base of the upper mandible; the anterior toes of the stout powerful feet are more or

less united together, the soles are broad and flat like those of a kingfisher, and the front of the tarsi and upper surface of the toes are scutellated. These birds have tolerably large wings, and appear to possess considerable power of flight, though from the weight of their bodies they are not very rapid. They are also furnished with a long and broad tail, which is sometimes rounded at the extremity, sometimes very long and graduated.

The hornbills are inhabitants of the warmer parts of the Old World, being found in Africa, India, the Malay Archipelago, and New Guinea. They are generally ungainly birds of large size. In a state of nature their food consists principally of fruits. Insects also form a large proportion of their food, while some species kill and devour serpents, lizards, and even fish. Lesson says that the Eastern species are very fond of nutmegs, from which their flesh acquires a delicious flavour. They usually live in flocks in the forests, where they are fond of perching upon the highest branches of the trees. During flight the head is drawn back, and the movement of the wings is very rapid, producing a considerable rushing sound as the birds pass through the air. This is heightened by a constant clattering of the large mandibles, and the occasional utterance of a loud croak. The nest is built in holes of trees, where the male plasters up the female with mud, leaving only a small hole for her bill. The female makes a nest of her own feathers, in which she lays and hatches her large white eggs, and is not released from her prison till her young brood are fully fledged. During all this time she is constantly fed by her partner, who in consequence of his protracted exertions becomes very lean and weak. The male hornbill is remarkable for his habit of vomiting his food wrapped in a gizzard-sac formed of the epithelial layer of the gizzard, and it is probably in this way that he feeds his mate during her imprisonment.

The Rhinoceros Hornbill (*Buceros rhinoceros*) is one of the largest species of the family, measuring about 3 feet in length, with a bill of about 10 inches long. Its plumage

Buceros rhinoceros.

is black, with the lower part of the belly, the legs, and the rump white; the tail, which is long and broad at the extremity, is also white, with a broad black band crossing it beyond the middle; the enormous bill is red at the base, yellowish at the apex, and the upper mandible bears a very large appendage at its base, extending nearly half the length of the bill, and turning up at the extremity to form a sort of horn. This bird is found in the Malayan peninsula and the adjacent islands. *Buceros cavatus* is a similar species from India, Java, and the Malayan Archipelago. The Helmet Hornbill (*Rhinoplax galeatus*), a native of Sumatra and Borneo, is remarkable for the great strength and solidity of the basal appendage of the upper mandible, which is of great size, but forms a simple protuberance at the base of the bill, rounded above, and cut off nearly straight in front; this helmet, with the corresponding part of the bill, is deep red, the rest of the bill is yellowish. This is a large species with a greatly developed tail, of which

Buceros cavatus.

the two middle feathers are much longer than the rest. The birds forming the genus Toccus, although very closely allied to the most typical hornbills, are nevertheless distinguished from them by the total absence of any casque or excrescence at the base of the upper mandible. The Red-billed Tocko (*Toccus erythrorhynchus*), which is very abundant on the west coast of Africa, is about 20 inches in length, with a bright red bill of 3½ inches long. Its head is adorned with a tuft of slender plumes, which, with the whole of the back of the neck, are variegated with black and white; the back is black, variegated with white; the whole lower surface is pure white; and the tail is blackish-gray, with the extremity white.

The ground hornbills (Bucorvus or Bucorax) are distinguished by their longer legs and shorter toes, and are confined to Africa. The Abyssinian Hornbill (*Bucorvus abyssinicus*) is a very large species, measuring about 45 inches in length. It feeds entirely on insects.

HORN'BLENDE (*horn*, from its toughness; and *blende*, blind, as although heavy it was valueless as an ore) is a rock-forming mineral of wide distribution, and occurs most frequently in rocks of a basic character.

It may be defined as an aluminous-lime, magnesia-iron amphibole, with a specific gravity of from 3 to 3·5, and hardness of 5 or 6, and rather a tough mineral. It crystallizes in the monoclinic system, the most common form being a stout prism; the ends are sometimes dissimilarly terminated, owing to twinning and hemitropism along the orthodiagonal plane; long blade-like crystals also occur; the colour varies from green to black.

Hornblende is an important constituent of such rocks as SYENITE, DIORITE, and its presence produces varieties in granite, gneiss, and schist; from its quality of toughness it generally improves the stones for economic purposes, and is specially suited for paving setts.

In the determination of rocks it is often of great importance to distinguish between hornblende and AUGITE. In hornblende the planes of the prism are inclined to each other at an angle of about 124 degrees, an angle differing widely from a right angle, whereas in augite the angle is about 87 degrees—nearly approaching a right angle. In hornblende the cleavage is very perfect and parallel to the orthopinakoid, while in augite it is indistinct, and the angle of intersection is distinctive. In thin sections hornblende is strongly dichroic.

The most common varieties of this mineral are actinolite, ASBESTOS, mountain or rock cork, mountain leather, tremolite, grammolite, uralite, basaltine, &c.

HORN'BLENDE GNEISS differs from ordinary GNEISS in having the mica largely and sometimes wholly replaced by hornblende, and the felspar being in a measure plagioclastic. When the rock is almost wholly composed of hornblende, and has a foliated structure, then it is termed hornblende schist; but if the foliated or schistose structure be absent it is simply hornblende rock. The foregoing are of metamorphic origin, and have been produced from sediments of a basic or of a tufose character.

HORN'BLENDE GRANITE may result from the extreme metamorphism of hornblende gneiss, or it may be of plutonic origin; it is a crystalline granular rock, composed of quartz, felspar, mica, and hornblende. It may therefore be regarded as a granite in which the mica (usually a magnesia variety) has been replaced by hornblende. Sometimes the mica is absent, when the rock approaches *quartz-syenite*. In hornblende granite the felspar is largely represented by plagioclastic varieties; in this it approaches and sometimes passes into DIORITE. Accessory minerals are not uncommon, especially magnetite and sphene. Hornblendic rocks are of some economic importance, especially for firestones, road metalling, and paving stones; they are tough, and do not wear smooth rapidly like ordinary granite.

HORNBOOK was the name of a now obsolete piece of apparatus of the ancient dame schools. It consisted usually of a thin board or leaf of vellum painted with the letters of the alphabet, a few simple syllabic combinations of them, the numbers and sometimes the lowest rudiments of arithmetic, &c. Over this complete school library was placed a thin plate of horn, the use of which could not be better given than by the poet Shenstone in his admirable "Schoolmistress":—

> "Their books of stature small they took in hand,
> Which with pellucid horn secured are,
> To save from finger wet the letters fair."

The hornbook had usually a handle whereby to hold it the more conveniently, or to hang it at the child's girdle. After the introduction of printing the letters were printed on a sheet, which was then pasted behind the horn. The vowels were put in a row by themselves, and as usual in early documents, the whole "book" began with a large cross—whence the country name for the hornbook, the sampler, or the alphabet, the "criss-cross row" (Christ's-cross row). Amusing specimens are to be found in most museums of antiquities of any pretensions.

HORN'CASTLE, a market-town of England, in the county and 18 miles from the town of Lincoln, and 130 miles from London by the Great Northern Railway. Its trade is chiefly agricultural. The town has been considerably improved in recent years. The church, supposed to date from the time of Henry VII., has been restored, but contains several ancient monuments; there are several dissenting places of worship, and Queen Elizabeth's free grammar-school. The corn exchange contains a large room for meetings, concerts, &c. The Horncastle great horse fair, held in August, is perhaps the largest horse fair in the kingdom. Horncastle is supposed to be the Roman *Bannovallum*, and later on was the English *Hyrn Ceastre*, or "castle at the angle." The population in 1881 was 4818.

HORNE TOOKE. See TOOKE.

HOR'NET (*Vespa crabro*) is the largest species of WASP (Vespidæ) found in Britain. In this country it is found chiefly in the southern counties, building its nest in hollows of trees. It passes the winter in deep holes, which it excavates in decayed trees towards the end of autumn. It is very voracious, preying especially on bees. The sting is very painful and dangerous.

HOR'NET MOTH (*Sphecia apiformis*), one of the Clear-wings (Ægeriidæ), presents an extraordinary resemblance to a hornet in size, colour, and appearance. The thorax is dark brown, and the abdomen yellow, banded with dark red, and the wings are quite transparent. The larva bores into the interior of poplars.

HORN'ING, LETTERS OF, in the law of Scotland, were the first step of the old process under which the arrest of a debtor was competent. By a legal fiction no person could be incarcerated for a civil debt. But on the application of the creditor a charge or legal demand was made upon the debtor to pay within a certain period, and if this was disregarded, the debtor was denounced at the market cross of the sheriffdom as a rebel to the king, as having disobeyed the royal command to make payment to the creditor. This ceremony was performed by messengers-at-arms after three several blasts of the horn. The instrument which embodied the charge to pay, and the command of the sovereign to proceed to denunciation and horning, was from the ceremony above described, and from the form in which it was framed, called letters of horning; and on the execution and registration of these, letters of caption followed, in virtue of which the creditor could proceed to apprehend and incarcerate his debtor. These cumbrous and complicated forms, though by no means abolished, were practically superseded by the provisions of the Personal Diligence (Scotland) Act, 1 & 2 Vict. c. 114.

HORN-LEAD, PHOS'GENITE, or **CROM'FORDITE,** an admixture of the chloride and carbonate of lead. It is a mineral of rather limited occurrence, has a hardness of 2·75 to 3, and specific gravity of 6 to 6·31.

HORN'PIPE is a very ancient English dance, much modified in its present form, and deriving its name from being danced to the music of a simple antique wooden pipe of the small oboe character, ending in a bell, probably made of horn. The rhythm is now always in $\frac{4}{4}$ time, but it used to be more varied. The dance seems always to have been a solo dance in character. We have the sailor's hornpipe, the fisherman's hornpipe, the college hornpipe, the monkey's hornpipe, &c. Each one has some characteristic steps introduced. The first is the only one which is now danced. The tune of the British Grenadiers is usually claimed as originally a hornpipe. The College Hornpipe is at once the finest and the most favourite tune of the kind.

HORN-SILVER or **CERARGYRITE** is a most valuable ore of silver. It is the native chloride of that metal, and contains from 68 to 76 per cent. of silver; has a specific gravity of 5·4, and hardness of 1 to 1·5; and is sectile, cutting like wax, hence the appellation of horn. It occurs usually massive, and was worked formerly at the famous Potosi mines, and in other parts of Mexico and South America.

HORN'STONE or **PET'ROSILEX,** also sometimes called *Felsite* or *Eurite*, is an impure kind of FLINT, or cryptocrystalline variety of quartz. It is not unlike compact FELSPAR, but may be distinguished from it by being infusible. It is a hard, massive, compact substance, generally dark-coloured, either brown or yellowish, but may be gray or even bluish-green. Sometimes translucent, but more usually opaque, it breaks with a conchoidal, although more or less flat fracture, and is scarcely as hard as quartz.

HORNY TISSUE or **EPIDER'MOSE** is an albumenoid substance forming the basis of the epidermis of animals. Nails, hoofs, horns, hair, and wool, and also the feathers of birds, are constituted mainly of this material. It contains a considerable quantity of nitrogen and a little sulphur, and about 1 per cent. of ash. It resembles gelatin, but is insoluble in boiling water, though soluble in hot hydrochloric acid, and also in caustic potash, which eliminates ammonia. It melts when heated, and burns with a characteristic odour. The following analyses, which

show considerable uniformity in such diverse substances, have been published by Mulder and other chemists:—

	Hair.	Nails.	Wool.	Horn.	Hoof.	Feathers.
Carbon, .	49·9	50·3	50·0	51·6	50·4	51·8
Hydrogen, .	6·4	6·9	7·0	6·8	6·8	7·1
Nitrogen, .	17·1	17·3	17·7	16·6	16·8	17·6
Sulphur, .	...	3·2	...	5·0	3·4	...
Oxygen, .	...	22·3	...	20·0	23·4	...
		100·0		100·0	100·0	

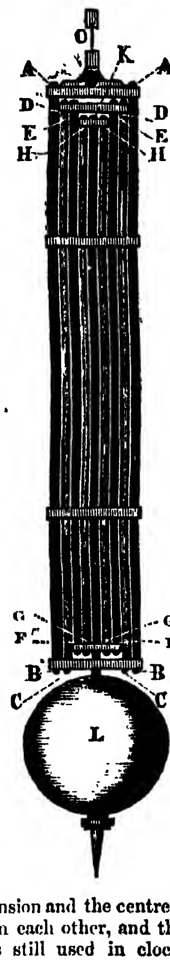
HOROL'OGY (Gr. *hora*, a defined portion of time; and *logos*, a discourse), a term usually applied to signify that science which regulates the action of the various machines used for the purpose of measuring time. The practice of measuring time by hours, minutes, and seconds is of comparatively recent date; yet we find advances early made in the computation of larger periods of time by observations of the heavenly bodies. Thus time was anciently divided into years, according to the motion of the sun among the constellations; into months, according to the motion of the moon relatively to the sun's place in the heavens; and into days, by the alternate light and darkness caused by the rising and setting of the sun. The earliest attempt made to divide the day itself was by tracing the shadow of an upright object, which gave a rough measure of time by the variations of its length and position, or, in other words, by means of the sun-dial. Hour-glasses belonged to this plan of determining gross amounts of time by a rough-and-ready mechanism, and the clepsydra was contrived for the same purpose. In the former case the running of fine sand from one vessel to another was the method adopted, and in the latter the measurement of short periods of time was effected by the quantity of water dropped from one vessel into another.

History of Clock-making.—The origin of clockwork is involved in great obscurity. Some maintain that clocks were invented by Boethius early in the sixth century; and that Pope Paul I., about 760, made a present of one to Pepin, king of France, which was then supposed to be the only clock in the world; others give the honour to Pacificus of Verona, in the ninth century, and assert that the striking part was invented by the Saracens. It is certain that a curious clock was sent to Charlemagne from the Caliph Haroun al Raschid, which the historians speak of with admiration. Mention is made of a clock having been put up at Westminster in the year 1288, during the reign of Edward I. Striking clocks were known in Italy as early as the latter part of the thirteenth or the beginning of the fourteenth century.

De Wyck's clock, made in 1379 for Charles V. of France, was a large striking clock, going for one day, and with but one hand (the hour hand). This ancient clock is illustrated in figs. 1, 2, and 3 of Plate I., and its mechanism, which may be said to be the parent of that of our modern clocks, is worth describing. The weight A tends to uncoil the cord and so turn the barrel B. From this the motion will be successively communicated through the train of wheels and pinions (or small wheels), lettered G *e* H *g* in the figure, to the scape-wheel I I, the teeth, *h*, of which so act on the two small leaves or pallets, *i k*, attached to the axis of the balance lever, L L, as to produce a vibratory instead of a circular motion in this lever. The hand of the clock was attached to the wheel, N, driven by the pinion, *n*, on the barrel axis. It is obvious that without the balance, L L, the weight would rapidly descend, driving the hands and the clock-train at a high speed; but the balance is loaded with two movable weights, *m m*, which are adjusted in position until their *inertia* produces a tolerably uniform rate of going. This balance is in fact very similar to that used in watches at the present day, with this exception, that it wants the balance spring on which the isochronism of the latter depends. Fig. 2 is a back view of the clock-train, and fig. 3 an elevation of the striking train of this clock, which is actuated by another weight, F, and barrel, G, with a train of wheels, H *d* K *e*, closely resembling the clock-train, except that it ends in a rotatory fan or fly, L, in place of an escapement. The train is set in motion by the wheel, N, of the clock-train lifting a detent, V.

It appears there is still a clock in existence at Dover Castle bearing the date 1348, earlier by about thirty-one years than that of De Wyck. In 1484–85 Walthas made a balance clock for astronomical observations. In 1560 Tycho Brahé had four clocks which indicated hours, minutes, and seconds, the largest of which had only three wheels, one having 1200 teeth. In 1577 Moesthin had a clock whose beats enabled him to determine approximately the apparent diameter of the sun. At what time watches or small clocks were introduced, by the use of a mainspring instead of a weight as the moving power, is uncertain. The earliest portable timekeeper of which any account has been given is one dated in 1525, made by Jacob Lech of Prague, and a good many years in the possession of William Beckett, a London clockmaker. The investigation of the mathematical theory and properties of the PENDULUM by Huygens, the Dutch philosopher, early in the seventeenth century, supplied what these ancient clocks required, a simple and trustworthy governor. It seems probable, however, that the first pendulum clock actually constructed was made by Harris, a London clockmaker, in 1621. In 1676 Barlow, another London clockmaker, invented the repeating mechanism, by which the hour last struck may be known by pulling a string. Several inventors followed in the same line, particularly Quare, in London, and Julien le Roy, Collier, Larcay, Thiout, &c., on the Continent. Clocks soon afterwards were made to show not only mean but apparent time.

Fig. 1.



Clement, a London clockmaker, invented in 1680 the anchor escapement, which was a great improvement on the crown-wheel before in use; he also introduced the practice of suspending the pendulum by a thin and flexible spring. The next important improvement was the adjustment of the length of the pendulum to the varied effects of heat and cold. In 1715 George Graham, by substituting a jar of mercury for the pendulum bob, succeeded in retaining the point of suspension and the centre of oscillation at an equal distance from each other, and this form of compensation pendulum is still used in clocks requiring great accuracy. The principal objection to this pendulum is its liability to breakage, of which its author felt the full force, and in consequence suggested the idea of the compensating expansions of different metals as a substitute for his form of pendulum.

The idea was worked out by John Harrison, who invented the earliest form of solid compensation pendulum, called from its shape the "gridiron," which is illustrated in fig. 1 above. The spring, O, by which the pendulum

is suspended, is connected with a cross-bar, from which descend the two *steel* rods, A A, supporting another cross at bottom, B B, on which stood two *brass* pillars, C C. These in turn support another cross, from which descend two more steel rods, E E, attached to a cross, F F, supporting another pair of brass pillars, G G, carrying another cross, H H, from which finally descends the steel rod, K, carrying the pendulum bob, L. It is evident that the expansion of the different metals in this combination will take place in different directions, and the lengths of the various rods are so proportioned that their expansions neutralize each other.

Since the introduction of zinc working on a large scale, however, compensation pendulums have been greatly simplified. As the expansion of this metal is more than twice that of steel or iron, it is sufficient to set a zinc tube on a nut at the bottom of a steel rod, and attach to the top of the zinc tube the upper end of an iron or steel one large enough to surround it and carrying the pendulum bob. If the lengths are accurately proportioned the expansion of the zinc upwards will neutralize that of the steel rod and tube downwards. The outer tube is sometimes replaced by two steel rods. About the same time with the invention of Harrison's pendulum (1726) George Graham introduced "the dead-beat escapement," which is described in detail below.

Mechanism of a Clock.—A clock may be briefly defined as a train of wheels, of which the slowest is driven by a weight and cord or by a coiled-up spring, and the fastest is permitted, by means of a contrivance called the escapement, to move forward at the rate of one tooth for every swing or beat of the pendulum. The relative speeds of the various wheels are so regulated that one shall make a complete revolution once in every hour, and the axis or "arbor" of this wheel carries the minute hand. The hour hand is usually driven by a special train connecting it with the minute hand, though in some clocks it is attached to the arbor of a wheel in the clock-train, turning once in twelve hours. Fig. 4, Plate I., shows the arrangement of the "going part" of a common house-clock. The barrel, *a a*, is driven by the cord and weight, W. The cord is not actually attached to the weight, but passes through a pulley, as shown, and the free end is attached to the clock-frame or case, thus practically doubling the fall of the weight. The great wheel, *d*, rides loose on the barrel-arbor, *c*, and is connected with the barrel by a ratchet and click, *b*, so that on winding the clock the barrel alone moves in a reversed direction. The great wheel drives the centre pinion, *f g*, which turns in one hour, and its arbor, *e e*, goes through to the dial and carries the minute hand as shown. The centre wheel drives the second pinion, *h*, on whose arbor is a wheel which drives the scape-wheel, *q*, by its pinion, *i*. In ordinary clocks the pinions have generally eight leaves or teeth each, and the wheels in that case have ninety-six, sixty-four, and sixty teeth respectively if the scape-wheel turns once a minute. In the best clocks the scape-wheel arbor, *j*, comes through the dial and carries a seconds hand, as shown in Plate. The minute hand is not fixed rigidly to the centre arbor, or the clock could never be altered. It is therefore mounted on a tube, T, which is carried along with the centre arbor by the friction of a small spring shown behind the wheel, *u*. This wheel, which is secured to the tube, T, drives another wheel, *v*, of its own size, which again by means of its pinion, *t*, containing one-twelfth of its number of teeth, drives the wheel, *s*, one-twelfth of a revolution for every complete turn of the minute hand. This wheel is mounted on another tube, which carries the hour hand of the clock. A, B, C is the clock-frame, and F F the dial. It is evident that the rate of the whole clock depends on the accuracy with which the escapement governs the movement of the scape-wheel, *q*. The escapement, *k*, itself is connected with the pendulum by a contrivance called the crutch (I) and fork (*m*), which interferes as little as possible with the swing of the pendulum, *p n o*. The first form of escapement was the crown-wheel and pallet shown in De Wyck's clock (figs. 1 and 2). This was replaced by the anchor escapement, a very similar form, but in which the teeth of the scape-wheel were radial in place of parallel to its axis, and the pallets took a form similar to an anchor. This escapement is shown in fig. 7 of Plate II.: B P C is the scape-wheel moving from right to left, and F F the escapement swinging on the axis, A. The pallets, *m b*, *n e*, have sloping faces, on which the teeth, B C, of the scape-wheel successively fall, and sliding down the slope they impel the anchor alternately to right and left. At every vibration a tooth of the scape-wheel escapes from one of the pallets. It was found that in both these escapements there was a "recoil," that is, at each beat the pendulum drove the clock a little way backwards, while the clock-train acted on the pendulum during nearly the whole of its swing. Every variation in the force of the clock-train, therefore, was communicated to the pendulum, and greatly affected the steadiness of its rate. To obviate this objection Graham introduced the "dead-beat" escapement, shown in fig. 8, Plate II., in which the acting faces of the pallets, *a b c* and *g h i*, are divided into two portions. One portion, *b c* and *g h*, forms an arc of the circle described by the pallet in its swing, and therefore can neither receive nor give any impulse whatever. This is called the *dead* or *locking face* of the pallet. Another part of the face, *a b* and *h i*, is sloped, as in the old anchor escapement, for the purpose of receiving the impulse necessary to overcome the friction of the pendulum. This is called the *impulse face*, and as its extent is the same whatever may be the swing of the pendulum, the clock is much less liable to variation of rate. Under various forms the principle of this escapement is still used in the finest astronomical clocks of the present day. In some cases the radial teeth of the scape-wheel are replaced by pins projecting from its face, in others the pallets themselves are pins (generally of ruby), and the dead face is formed by the acting side of the tooth of the scape-wheel, only its point giving the impulse.

It is evident, however, that in clocks requiring great accuracy there is a chance of error wherever the impulse of the clock-train is directly communicated to the pendulum at all, as the best made trains will not at all times transmit the same force. This difficulty has been met by the invention of the "remontoir," a contrivance by which the clock-train does not directly drive the scape-wheel, but winds a spring or raises a weight to a fixed and uniform height at regular intervals, which drives the scape-wheel by its fall. A contrivance of this kind in connection with the dead-beat escapement is generally used in clocks of moderate size and requiring great accuracy. For clocks of the largest size, such as turret clocks, however, the remontoir principle has been applied successfully to the escapement itself, in this case called a "gravity escapement." The form in most general use is that invented by Sir Edmund Beckett, Q.C., and used in the great clock at Westminster. Its mode of action is as follows:—The pallets are not attached to each other, as in the dead escapement, but are entirely separate; the scape-wheel lifts them alternately to a fixed height, and then becomes locked. Up to this point they are not in contact with the pendulum at all. When the latter, in the course of its swing, comes in contact with the "beat-pin" attached to the pallet it releases the scape-wheel, which at once moves forward a step, but without communicating any impulse to the pendulum. The motion of the latter is maintained entirely by the descent of the pallet from the position to which it had been raised to the vertical, thus acting by its own weight only, through an unvarying arc of vibration. In

the meantime the other pallet has been raised by the scape-wheel to its highest position, and is ready to be released by the return of the pendulum.

The striking arrangement most commonly in use in large turret clocks, as well as in nearly all the small clocks of foreign make so extensively used in this country, is shown in figs. 5 and 6, although the actual arrangement of the different pieces may vary. It is called the locking-plate arrangement, and acts as follows:—The pin *v* (fig. 5), on one of the wheels of the dial, which revolves once an hour, lifts the lever *h*, and by means of the axle *g* the lever *i* is also lifted. This raises the lever *j k* and its other two arms, *k l* and *k m*, the former of which rests in a notched wheel, *n n* (attached to the barrel), and the latter against a stop attached to the toothed wheel *c*. By this means the only obstacle to the motion of the clock-train is removed and it commences to run down, the fly *f* regulating its speed. The tail of the hammer H is raised by a series of pins projecting from the wheel *b* (fig. 5), and the hammer is impelled to strike the bell B by the spring *s* (fig. 6). So long as the lever, *k l*, rests on the circumference of the wheel, *n n*, the striking continues at a regular rate; but as soon as another notch comes under the end of this lever it falls, carrying with it the arm *k m*, which engages the stop on the wheel *c* and checks the train. The number of strokes on the bell is therefore regulated by the distance between the notches on the *count-wheel* or *locking-plate*, *n n*. The motion of the train is derived from an independent weight attached to the cord on the barrel *a a*, which is wound up like that of the clock-train.

The striking part of an English repeating clock is shown in fig. 9, Plate II., which is a front view. Its action is as follows:—The dial wheel *m* has a pin in its face which raises the lifting piece *l k j* a little before the hour, just far enough for it to lift the click *h* on the lever *d f g* out of the teeth of the rack *b l*, which then falls back as far as its tail can go, on account of the position of the "snail" *a* on the hour wheel, which has stops on it, one for each hour, so that the rack can fall only the distance of one tooth for every hour the clock has to strike. This fall of the rack makes a noise called *warning*, a few minutes before the clock strikes; but it cannot actually begin striking until the lifting piece, *l k j*, falls again, which it does exactly at the hour by the advance of the pin in the wheel *m*. Then the striking train is released by a detent at *j*, which had checked the wheel C; the wheels revolve, and the gathering pallet *i*, which is fixed in the arbor of the wheel B, gathers up the teeth of the rack, one for each blow of the hammer. The click *h* is lifted as each tooth passes, but prevents the rack from falling again, until at last all the teeth are gathered up and the tail of the pallet *i* is stopped by the pin *p* on the rack. The main feature of the English striking work is that you may cause the clock to strike as often as you like within the hour, and yet it will always strike right, because the striking depends on the position of the snail *a* attached to the hour wheel, and not at all on the hour last struck, as in most foreign clocks. A lever, *g r q*, and cord are usually added, so that by pulling the cord it can be made at any time to repeat the hour last struck. The speed of the train is regulated by a rotating fan D, called a fly, to which motion is transmitted by the wheels A, B, and C. The tail *e* of the hammer E′ E is lifted by eight pins on the wheel A, one of which is shown at *w*, and F is the hammer-spring. The piece, *s t u*, is intended to throw the lifting piece, *j k l*, out of gear when it is desired to prevent the clock striking. Small clocks are frequently driven by a spring coiled inside the barrel in place of a weight. As this varies in power with the extent to which it has run down, a contrivance called a fusee is introduced in the best clocks to equalize the force, which will be described when we treat of watches.

Astronomical Clocks.—These are simply standard clocks, most frequently used by astronomers, and especially contrived for them. A good astronomical clock should be as simple as possible in construction, and all resources of practical science should be drawn upon to render its parts in perfect accordance with theory. To prevent the possibility of error, the hours on these clocks are numbered from I. to XXIV., and there is no such distinction as A.M. and P.M. in astronomical time—a mode of reckoning which the authorities of Greenwich Observatory proposed to extend to ordinary clocks in 1885. The hour, minute, and seconds hands usually have separate dials for each. The escapement is the dead-beat, protected from variations of force by a remontoir on the clock-train. The pendulum generally used is the mercurial already described.

The art of horology would be very incomplete unless there were some standard, independent of all mechanical contrivances, to which all may be referred, and by which the errors of each time-keeping instrument may be corrected. The movements of the heavenly bodies are still, as of old, the only standard for a general measurement of time, affording as they do marks of unvarying certainty, to be read by all alike; and clocks and other mechanical contrivances are individual and imperfect measures of the intervals, to be trusted only until there is a new opportunity of comparing them with the certain and public signals of the heavens. These signals can, however, only be accurately read by persons furnished with the proper apparatus and informed sufficiently in its use. This is done in observatories, and there are now in most parts of this country sufficient opportunities of setting clocks by a communication more or less direct with these establishments. The time which a clock ought to mark is *mean time*, which is the average length of all the solar days in a year, and a solar day is the interval between two successive transits of the middle of the sun over the meridian. The *mean time* at any *place* depends on the longitude. Supposing a clock to be set to Greenwich mean time, as usual in England, a clock keeping mean time of any place will be four minutes faster for every degree of longitude east of Greenwich, and four minutes slower for every degree west.

The methods by which time is determined in observatories belong to practical astronomy. [See TIME.] For the more ready transmission of correct time to the public, there is at Greenwich Observatory, as well as at some other places, a ball which is dropped by means of electricity precisely at one o'clock. Recently, however, there has been generally introduced a most ingenious device by which public clocks in a town can be kept at every instant in perfect agreement with the mean-time clock in the observatory by means of an electric connection. The earliest public application of it was to the town-hall clock in Liverpool, when for the first time was seen the curious spectacle of a great clock with works nearly 100 years old keeping time with astronomical accuracy. In the same way, a clock in the Castle of Edinburgh, by whose mechanism a gun is fired precisely at one o'clock every day, is controlled by the mean-time clock in the observatory on the Calton Hill.

Large Pendulum Clocks.—Turret clocks differ from other machines employed for measuring time, not only in their greatly superior size, but because such a clock is frequently required to indicate the time upon as many as four different dials, on the four external faces of the tower in which it is mounted. This is accomplished by placing the clock near the centre of an apartment, and causing the motion of the axis, which under ordinary circumstances would carry the minute-hand (which revolves once in an hour), to be transmitted by bevel-gear to a vertical rod, the opposite end of which carries a horizontal bevel-wheel nearly on a level with, and situated centrically in reference to, the four external dials. The motion of this central wheel is communicated by four vertical bevel-wheels of the same size

and number of teeth, ranged round its circumference, to four horizontal rods, the opposite ends of which, passing through the several dials, carry the minute hands. At the back of each dial is a series of wheels and pinions, imparting motion to the hour hand, which revolves once in twelve hours. In a turret clock the moving power is supplied by the descent of a weight, regulated in the case of the movement or going train by the oscillations of a large pendulum, and in that of the striking train by the resistance of the air to the rapid revolutions of a fly or fan set in motion by the wheel-work. Owing to the necessity for using a very heavy hammer to strike the hours in a church clock, the power required for working the striking-train considerably exceeds that of the going train.

The escapement in this form of horological mechanism is of the highest importance, and the performance of the piece depends much upon its soundness of principle and excellence of workmanship. As it is obvious that the power required to drive the hands of a turret clock exposed to the weather must be much greater, and is also liable to greater variations than in any other clock, the gravity escapement already described, which cuts off from the pendulum the direct influence of the clock-train, has found much favour. Dials for turret clocks should be slightly concave, and the material may be of slate, stone, or cast-iron painted, or opal glass when they are to be illuminated at night.

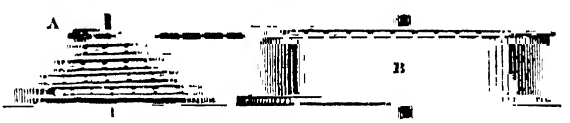
Of large clocks the Westminster clock is the finest in England, perhaps in the world. The annual reports of its performance show that on 84 per cent. of the days of observation its errors are under two seconds, on 14 per cent. under three, and on 2 per cent. between three and four seconds—as tested by the master-clock at Greenwich Observatory.

Musical chimes require the addition of another train of mechanism to that of the ordinary turret clock, somewhat like that which constitutes the striking train. The mechanism of the chimes very nearly resembles, on a large scale, that of a musical box; levers, connected with hammers which strike upon a series of bells, being substituted for the springs which in the musical box are caused to vibrate by the projecting pins on the revolving barrel.

When clocks and watches had acquired a certain degree of accuracy in their performance, the time lost in winding up (especially when it had to be done every twenty-four hours) became a matter of importance, and there have been several inventions to remedy this evil. By Huyghens the clock was kept going while winding up by means of an endless cord. But Harrison's contrivance for the same purpose is the one now in general use, both in clocks and watches, and is admirably adapted to the purpose, as it requires no attention from the person who has to wind up the machine, but is always in its place, and ready for action the moment the operation of winding is commenced. It consists of a spring interposed between the ratchet of the barrel and the great wheel in such a way that even while the barrel is being wound the spring continues to act on the great wheel and keeps the clock in motion.

Watches and Chronometers.—These have a coiled spring instead of a weight for their maintaining power. Watches seem to have been made as early as the sixteenth century, though Dr. Hooke in the seventeenth was the first discoverer of the important law respecting springs, which he enunciated in the well-known words, *ut tensio sic vis*—the force of a spring varies as the bending of it. The most simple form of mainspring arrangement for a clock or watch is that where the spring, which is a narrow strip of tempered steel, has its inner end attached to the arbor, which ends in the winding square having a ratchet set on it with the click in the clock-frame. The other end of the spring is fixed to the barrel, which is the great wheel of the clock or watch. And one advantage of this is, that there is just the same pressure on the train, or the wheels and pinions placed between the uppermost frame-plate and dial, when you are winding up as at any other time, and no temporary maintaining power is wanted. But it will be obvious that by virtue of the rule *ut tensio sic vis*, there must be a much greater force on the train when the watch is wound up than when it is nearly run down. This plan is generally adopted in watches of foreign make, while English watches, as a rule, have a *fusee* to regulate the force of the spring. This contrivance, shown at A in fig. 2, is a sort of grooved cone, with a concave section; the more rapid swell towards the thick end is required because one turn of the fusee, when the chain is at that end, takes much more off the barrel B, containing the mainspring, than at the thin end; and on the assumption that the force of the spring varies according to its tension, the radius of the cone must increase more rapidly, in order to make the increase of leverage keep pace with the decrease of the force of the spring. When the watch is wound up the whole of the chain is coiled round the fusee, and it is gradually unwound and wrapped round the barrel by the action of the spring. The fusee itself is connected with the great wheel by a ratchet and click and going ratchet. Something is also required to prevent the watch from being over-wound. This is done by means of a hooked lever set

Fig. 2.



on a hinge in the upper frame-plate; and when the watch is nearly wound up, the chain moving upwards reaches this lever, and raises it in such a position that its hook catches a long tooth projecting from the thin end of the fusee, and thus the winding is stopped without any strain by the sudden check. The other parts of a watch do not differ from those of a clock, except in size and the position in which the parts are arranged to bring them within the circle of the dial, until we come to the escapement, and there a different state of things arises.

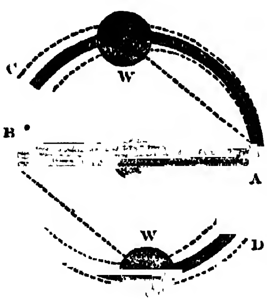
In a watch this combination consists of the scape-wheel, together with all those parts lying between it and the balance, which are concerned in converting the circular motion of the wheels into the alternating one of the balance, which takes the place of the pendulum of a clock.

The balance of a watch moves sometimes through a space equal to 270 degrees, while a clock pendulum only vibrates through 4 or 5 degrees. The balance being common to all watch escapements, it will be proper first to describe that, and the conditions to which it is subject. The two equal arms with equal weights at each end are really a balance just as much as the wheel, which is commonly used as the more convenient form; but in either case the isochronous motion of the balance is due to the *balance spring*, which is a fine spiral spring coiled or uncoiled at every vibration. The outer end of this spring is fixed to a stud in the watch, and the inner end to the arbor or staff of the balance.

The time of vibration varies inversely as the force of the balance spring and directly as the moment of inertia of the balance. It may therefore be changed by altering the length of the spring, as in a given spring the force varies inversely as its length, or by increasing or reducing the size of the balance. The former method is most commonly used in watches, and the latter in chronometers. A balance, however, is much more sensitive to changes of temperature than a pendulum, because, while a rise of temperature increases the size and moment of the balance,

it at the same time lengthens the spring, diminishing its power; and both sources of error act in the same direction. Compensation for temperature is therefore of the utmost importance in a balance. The first compensation balance was introduced by Harrison, and had the compensation applied to the spring; but in all modern chronometers the balance itself is compensated as follows:—The compensation balance consists of two arcs, A C, B D (fig. 3), attached by one end to a cross connecting bar, having the other end free to move. These arcs being composed of thin strips of steel and brass, the brass being outside, are so affected by heat as to curve inwards, carrying the weights, W W, nearer to the centre as indicated by the dotted lines, and thus diminishing the effective diameter of the balance, at the same time that the strength of the spring is relaxed by expansion.

Fig. 3.



It is obvious that by moving the weights, W W, nearer the ends C and D, the compensation is increased, and by moving them the other way it is reduced. The decrease of temperature straightens the arcs, the increase curves them in greater degree. The metals forming the compensation balance of the watch are generally soldered together by pouring melted brass round a solid steel disc, and the whole is afterwards turned and filed away till it only leaves a cross-bar lying flat in the middle, and the two portions of the rim lying edgeways. The first person who practised this method of uniting them appears to have been Thomas Earnshaw, who brought the chronometer very nearly to its present state of efficiency. The form of compensation balance in most general use is shown in fig. 10, Plate II. The screws, *e e*, distributed round its circumference, afford a ready means of regulation, as they can be screwed towards or from the centre of the balance as well as moved along the arcs A C, B D, to adjust the extent of the compensation. Kullberg's balance is a contrivance the distinguishing feature of which is that the rim, instead of being upright, is saucer-shaped, causing the balance to flatten itself in the cold. This tendency is promoted by making the radial bar compound, and increasing its action by tripling it laterally, so that the term "gridiron balance" has been erroneously given to it.

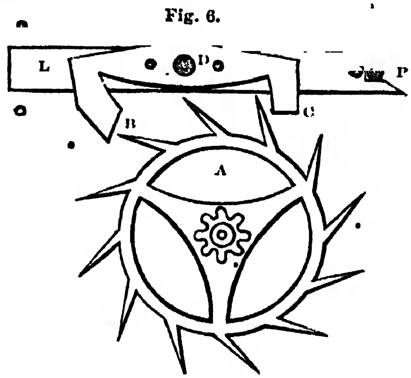
In this description of balance the brass is attached to

Fig. 4.

the top of the cross-bar A C (figs. 4, 5), and to the bottom of the curved rims A B, C D. The ends of the cross-bar are therefore carried downwards by heat, and those of the rims upwards, and of course nearer the centre of the balance. E E are the timing screws.

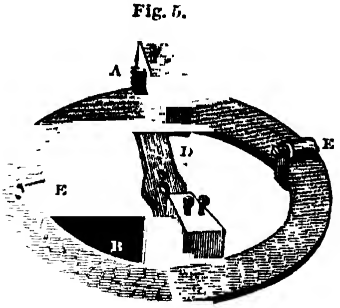
The escapement proper is that piece of mechanism through which the balance governs the motion of the wheels. In the earlier watches the crown-wheel and pallets, as seen in De Wyck's clock, were almost universally employed, under the name of vertical escapement, but now in watches of English make the "lever escapement," invented in its present form by Mudge, has entirely replaced it. This consists essentially of a dead escapement, on the principle

Fig. 6.



of Graham's for clocks B C (fig. 6), attached to a lever, L P, which turns on a pivot at D. At one end of this lever is a deep notch, and on a disc attached to the arbor of the balance is a pin, P, which enters this notch during a part of every vibration of the balance and moves the lever, allowing a tooth of the scape-wheel A to escape from one of the pallets. Through this pin also is the impulse given by the scape-wheel communicated to the balance; it will be seen that during the rest of its vibration, whether that is long or short, it is entirely unconnected with the escapement, while the scape-wheel remains locked against the dead face of one of the pallets B or C. The pins fixed on each side of the lever at L limit the extent of its vibrations. In most French and Swiss watches the "horizontal" or cylinder escapement is used. This was invented by Graham, and is represented in fig. 11, Plate II. It will be seen that the scape-wheel teeth are surmounted by a series of small wedges, A, E, C. The hollow cylinder, *d c l*, forms part of the verge of the balance, and vibrates round its centre, the portion between *d* and *l* being cut away. When the wedge-shaped tooth A strikes the outside of this cylinder it remains "dead" in its outer surface until the vibration of the balance brings the edge *l* level with the point of the wedge A. The tooth then passes into the interior of

Fig. 5.



the cylinder, giving an impulse as it does so. The point is now checked by the inside surface, as shown at E, until the reverse vibration of the balance allows it to escape to the position C. A somewhat similar escapement is the "duplex," so called because the scape-wheel has two sets of teeth, one for locking and the other for impulse. In fig. 12, Plate II., the locking teeth are lettered *f g h*, and the impulse teeth, or rather pins, *a a a*. On the verge of the balance are two cylinders, F G C and *o p q*, different in diameter. The smaller has a nick, *o*, and the larger a tooth, C. When the locking tooth *f* strikes the cylinder, *o p q*, it remains locked until the nick *o* passes in the same direction and permits the tooth to escape. At the same time the tooth C receives

the impulse from the pin *a*. In both these escapements it is clear that the balance is subject to constant friction. This is obviated in chronometers by the use of the "detached" escapement, represented in fig. 13. Here the scape-wheel, B C D, is locked by a detent, *m*, on the spring, *m* F *o*, which is double at the point, the fine spring G extending a little beyond the point *o*. On the balance verge are two cylinders, a large one, M S K, with an opening, *l h r*, and a small one, with a single tooth, *i*. When the balance swings in the direction S M K the tooth *i* lifts the light spring G and passes, but on its return it has to lift both G and F. Consequently the detent *m* is withdrawn and the tooth D escapes. At the same moment the tooth B enters the opening *l h r*, and gives the impulse on the face *l h*, which is jewelled. In this escapement the influence of the scape-wheel on the balance is reduced to a minimum.

Keyless watches have recently been generally introduced. In these the watch is wound and the hands set by a movable button, the stem of which passes through the pendant. By

Fig. 7.

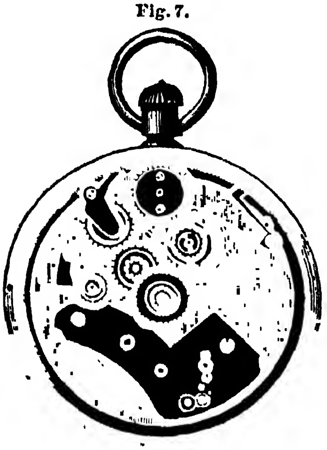


Fig. 8.

this system the watch-case does not require to be opened, and dust may be more effectually excluded. One of the systems employed for this purpose is shown in fig. 7. The wheel shown next the pendant is driven by a pinion connected with the movable button. The movable wheel to the left shows how motion can be communicated to the gearing of the hands when necessary. Fig. 8 has the ratchet and click removed to show a friction spring which throws the click out of gear, and so disconnects the winding mechanism during the going of the watch.

HORS DE COMBAT, a French term, meaning "out of the fight," "disabled." When a combatant or an army is incapable of further action—completely beaten—they are said to be *hors de combat*.

HORSA. See HENGEST.

HORSE (Equus) is a genus of ungulate mammals belonging to the family EQUIDÆ. The genus Equus, which contains all the recent members of this family, falls into two subgenera—Equus containing the horse, and Asinus containing the asses, zebras, &c. In Equus the mane is long and flowing, the tail densely covered to its root with long hair, the hinder as well as the fore legs are furnished with warty callosities, and the hoofs are broad and rounded. In the coat of the horse, moreover, there is a disposition to the formation of small round spots or rings of a different shade or hue from that of the ground; and this is the case whether the general colour be black, chestnut, or gray. In Asinus the mane is short, meagre, and upright, the tail is furnished with long hair only towards its extremity; the hoofs are contracted, and there are warty callosities on the fore legs, none on the hinder limbs. The ground-colour of the coat is more or less whitish (in the wild species), always with a distinct dorsal line of a dark tint, with stripes or bands of the same colour more or less pervading the body and limbs.

Till very recently no wild horse other than feral was known, and the distinction between these two subgenera was well marked. In 1880, however, the Russian traveller Przevalsky discovered in Central Asia a wild horse (*Equus przevalskii*) in certain respects intermediate between the true horse and the asses. This wild horse has warts both on its hind and fore legs, and broad hoofs like the true horse, and there is no dorsal stripe; but the mane is short and erect without a forelock, and the long hairs of the tail do not begin till about half-way down. This horse is small, with very thick and strong legs, large head and small ears. It is found in the wildest parts of the great Dsungarian Desert between the Altai and Thian Shan Mountains. It is met with in troops of from five to fifteen individuals, apparently all mares, led by an old horse. They are very shy and difficult to approach. This discovery is of extreme interest, as the best authorities consider that the wild horses of the East, no less than those of America and Australia, are descended from horses which have escaped from the service of man. One of these feral horses, the Tarpan, is found in immense numbers in the great treeless plains of Tartary. It is of a reddish colour with a black stripe along the back. At the discovery of America no indigenous horses were found, but they were soon introduced from Europe, and now on the pampas and the prairies of South America troops of wild horses scour the plain in perfect freedom, the descendants of a domestic race. The troops are composed of an immense number of animals, in some cases as many as ten thousand, all apparently under the command of one leader. These horses are captured by means of the lasso, and then broken in. In Australia troops of feral horses are also found.

It would appear that the horse was first domesticated or reclaimed in the East in prehistoric times, that it was brought with the hordes migrating westward from Asia, and was thus introduced into Arabia and Egypt, and that we must look to the deserts north of Hindustan and Persia as its cradle, or at least as the locality in which it first became subject to man. That the domestic horse was known in Europe in the Neolithic age is proved by the discovery of its remains, associated with the pig, sheep, goat, &c., in the Swiss pile-dwellings. At this time it was only used for food, but in the succeeding age of bronze it must have been used for riding, for bronze bits are found both in France and in Italy. Horses are not pictured on Egyptian monuments of an earlier date than the eighteenth century B.C., and from this it is probable that the Semitic people were indebted to the Aryans for the introduction of the horse. In the Bible this animal is rarely mentioned except in connection with war. That the art of riding was unknown to the Homeric Greeks is shown by the well-known story of the Centaurs, half men half horses, an idea which suggested itself also to the aborigines of America on seeing the Spanish cavaliers. In later days chariot driving and horsemanship rose to high importance in Greece. In the early days of the Roman state the *equites* or knights were the mainstay of the military forces.

The horse (*Equus caballus*) in a state of domestication

varies in size from the massive and gigantic dray-horse to the diminutive Shetland pony. Its colour is also as variable as its size, ranging through white, cream-tint, gray, mottled, iron-gray, dun, bay, chestnut, black, &c. It, moreover, presents us with different strains, how produced originally it is not easy to say; certainly the high-blood racer and the slight meagre Arab present strong contrasts in their contour and capabilities to the heavy Flanders horse and the huge dray-horse, rising from 18 to 20 hands high at the withers. Between these two extremes there are numerous intermediate breeds, some adapted for the chase, some for carriages and light-wheeled vehicles, some for the traveller's saddle, and some for farm-house labour. Ponies again, a small variety of the horse, show differences of a like nature—some are finely formed, full of mettle and courage, and show high blood; others are clumsy and ill-formed, though strong and hardy; and the intermediate gradations are numerous. Darwin considers it probable that all these various breeds are descended "from a single dun-coloured, more or less striped primitive stock, to which our horses still occasionally revert." In considering the causes of the modifications which horses have undergone, Darwin gives first importance to the varying conditions of life. Thus horses living on mountains and islands have become stunted from scanty and unvaried food. In this way Corsica, Sardinia, and the Shetlands are remarkable for breeds of small rugged ponies. Horses can withstand both intense heat and intense cold, but are injured by great humidity.

All English racehorses trace their descent to the ARAB or the BARB, the two fine breeds of horses from Arabia and North Africa. The English racehorse has well repaid all the care and attention which have been bestowed on him, and now both in form and swiftness surpasses the Arab and the Barb. The Americans have introduced a breed of horses remarkable for their trotting powers.

The intelligence of the horse, though far below that of the dog or cat, is considerable. Its memory, as many well-authenticated stories attest, is remarkably good. No other animal abandons itself so unreservedly to terror, losing even the instinct of self-preservation in its panic. It is very docile and affectionate. Horseflesh in prehistoric times formed part of man's food. It was used in Europe, especially in Scandinavia, till the custom was forbidden by the church. Beleaguered soldiers and citizens even nowadays are often compelled to resort to horseflesh for subsistence. Mare's milk is used extensively by some of the tribes of Siberia. The hide of horses is made into leather, and the hair used for haircloth, stuffing mattresses, &c.

Space will not admit of our attempting a description of the general anatomy of the horse. Several special works have been devoted to this subject, of which Percivall's "Anatomy of the Horse," and a treatise by Chauveau and Arloing (an English edition of which, by G. Fleming, appeared in 1873) will be found useful. The skeleton and muscular system are well illustrated in the Plates HORSE, prefixed to this volume. It will be sufficient to point out here that what is usually called the "knee" of the horse is the wrist or carpus, and that the "hock" is the ankle or tarsus; that the "cannon bones" are the metacarpal of the fore limb, and metatarsal bone in the hind limb; that the joint between these bones and the first phalanx ("greater pastern") is the "fetlock;" that the "pastern" is the joint between the first and the second phalanx ("little pastern" or "coronet"); that the third phalanx, which is imbedded in the hoof, is known as the "coffin bone."

The horse is naturally herbivorous; his thin muscular prehensile lips, his firm and compressed mouth, and his sharp incisors are admirably adapted for the purposes of seizing and cropping the grass; so flexible, indeed, are the lips, that the horse can pick up with ease the last few grains of oats in the manger. The crushing power of the grinders (molars) is extraordinary, the muscles of the lower jaw being of vast volume and energy; hence vegetable fibres, grass, grain, &c., are comminuted to a pulp. Nevertheless, it is doubtful whether in his natural condition the horse would select grain, were it obtainable, in preference to grass. The grinders in time become much worn by its attrition, and in many old horses the grain is only partially crushed, and consequently affords little nutriment. Hence, as a general rule, grain should be bruised before being put into the manger. Maize or Indian corn is often given to horses in place of oats; it is, however, unfit for hunters. Beans should be given now and then in small quantities to hunters and horses from whom hard work is required. Bran in the form of a mash is given as a laxative; and carrots given occasionally keep the blood in good order.

As the age of a horse is ascertained by an inspection of its teeth, or rather its incisor teeth, a knowledge of the process of dentition, and of the exact character of the incisors at different periods of a horse's life, is indispensable to the veterinarian, the dealer, and the purchaser. The incisors, of which there are six in each jaw, have their crowns excavated by a pit which extends to a considerable depth, and is partially filled up with cement. In the young horse this pit in the incisors is very conspicuous from its dark colour, and constitutes the "mark." As the tooth wears away the mark becomes obliterated. At six years of age the mark is obliterated in the central pair of incisors (nippers), at seven in the next pair, and at eight in the corner pair. Many artful and indeed barbarous tricks are played by horse-dealers to give an apparent age to a colt, and thereby enhance its value, and after maturity to give the teeth that appearance which they had when the animal had but just attained to its prime of vigour.

The general management of the horse is a matter of serious consideration. The treatment of the foal, the best time for weaning (at five or six months old), the breaking in of the colt, and the proper method to be pursued (on the principle of kindness, not of tyranny or brutal usage) according to the breed and destination of the animal; the training of the racer, the hunter, the roadster, the coach-horse; the amount of labour to be exacted from the working horse in the waggon, the cart, the plough; the diet required under every different phase of labour and at different seasons of the year; the kind of water (soft, if possible) to be given, and the quantity daily under different circumstances—all these are most important matters to be attended to.

Again, with respect to the anatomical structure of the foot, the qualities of the hoof, the nature and use of the frog, the bearing of the pastern bones on the coffin bone, with their ligaments, tendons, nerves, and bloodvessels; and the inference to be drawn, on physiological principles, as to the proper method of shoeing the hoof, according to the destined work of the animal and the nature of the ground upon which it has to work—these form additional points of great importance to which the veterinarian has to devote deep attention.

What is the proper *conformation of the horse?* This varies essentially with the breed and destination of the animal. Nevertheless there are some points which are valuable in horses of every description. The head should not be disproportionately large, and should be well set on—*i.e.* the lower jaw-bones should be sufficiently far apart to enable the head to form that angle with the neck which gives free motion and a graceful carriage to it, and prevents its bearing too heavy on the hand. The eye should be large and a little prominent, and the eyelid fine and thin. The ear should be small and erect, and quick in motion. The lop-ear indicates dullness or stubbornness; and when it

is habitually laid too far back upon the neck, there is too frequently a disposition to mischief. The nostril in every breed should be somewhat expanded: it can hardly be too much so in the racer, the hunter, the roadster, and the coach-horse, for this animal breathes only through the nostril, and it would be dangerously distressed, when much speed is required of him, if the nostril could not dilate to admit and to return the air. The neck should be long rather than short. It then enables the animal to graze with more ease, and to throw its weight more forward whether he is in harness or galloping at the top of his speed. It should be muscular at its base, and gradually become fine as it approaches the head. The withers should be somewhat high in every horse, except perhaps that of heavy draught, and it does not harm him, for there is larger surface for the attachment of the muscles of the back, and they act at greater mechanical advantage. A slanting direction of the shoulder gives also much mechanical advantage, as well as an easy and pleasant action, and a greater degree of safety. It must not, however, exist in any considerable degree in the draught-horse, and particularly the heavy-draught horse. The chest must be capacious, for it contains the heart and the lungs, the organs on which the speed and endurance of the horse depend. Capacity of chest is indispensable in every horse, but the form of the chest admits of variation. In the waggon-horse the circular chest may be admitted, because he seldom goes at any great speed, and there is comparatively little variation in the quantity of air required; but in other horses the variation is often excessive. The quantity of air expended in a gallop is many times that required in hard work. Here we must have depth of chest, not only as giving more room for the insertion of the muscles, on the action of which the expansion of the chest depends, but a conformation of the chest which admits of that expansion. That which is somewhat straight may be easily bent into a circle when greater capacity is required; that which is already circular admits of no expansion. A few words more contain almost all that is necessary to be added on the conformation of the horse:—"The loins should be broad, the quarters long, the thighs muscular, and the hocks well bent and well under the horse." The chief varieties of horses are the racehorse, hunter, hack, cob, charger, carriage-horse, Galloway, pony, and cart-horse. A pony must be less than 13 hands (52 inches) high; a Galloway is a horse between 13 and 14 hands high.

Under the impression that a serious scarcity was arising, a select committee was appointed in 1873 to inquire into the capability of the country to supply any present or future demand for horses. It was shown that a scarcity did indeed prevail, but rather through the supply not having kept pace with the demand than through any falling off in numbers; and in the opinion of the committee it was considered better to look to private enterprise for an effectual remedy, rather than to legislative enactments. The number of horses in England, as ascertained by the committee, was 962,548; and in the whole of the United Kingdom, 2,665,807.

Diseases of Horses.—In the medical and surgical treatment of the horse a knowledge of the anatomy and physiology of the animal is absolutely essential, and forms a basis for an accurate acquaintance with the numerous diseases which befall the horse, their symptoms, prognosis, and mode of treatment; the properties of the medicines, vegetable or mineral, employed; the effects of chemical combinations, and the various doses from which certain effects result. Wounds, fractures, dislocations, ulcers, and a whole class of what are called surgical diseases requiring manual as well as medical treatment, demand a union of the surgeon and physician in the same practitioner. It is not intended to recommend every owner of a horse to dabble in physic or surgery; but as there are cases in which common sense is a sufficient guide—namely, those in which promptness alone can save—the owner should act boldly; the horse will die if he does not, and can but die if he fails. It is in cases of sudden congestion of the brain, threatening apoplexy, that this promptitude is especially needed. Suppose one is driving or riding a high-fed horse, one perhaps that has been pampered and kept for some time out of work; suddenly he stops, reels, staggers, and falls, and then plunges violently and desperately. What is to be done? Bleed instantly—if possible before the horse falls. If no lancet or fleam is to be had, a sharp penknife will do. Bleeding can only be learned practically, and every traveller and every man who keeps horses ought to learn the art and have a lancet ever in readiness.

HORSE is a miner's term for large blocks of unproductive rock which often occur in lodes, practically dividing them into two portions. "The lode is horsed," or "took a horse," means that the lode has become split or divided.

HORSE-CHESTNUT (Æsculus) is a genus of trees or shrubs belonging to the order SAPINDACEÆ. There are fourteen species, natives of North America and the mountainous regions of Mexico, New Granada, Persia, the Malay peninsula, and also of the Himalayas. The calyx is five-lobed, campanulate, or tubular; there are four or five petals; five to eight stamens inserted within an annular or unilateral disc; the ovary has three cells with two ovules in each, ripening into a three-valved capsule, containing only one seed. The leaves are opposite, digitate, with five to nine leaflets.

The Common Horse-chestnut (*Æsculus Hippocastanum*) is a highly ornamental tree, and accordingly is extensively planted in the British Isles and the Continent. It has dark green foliage, appearing very early, so that occasionally a fine tree is spoilt by its leaves being frostbitten. The flowers are handsome, of a white colour tinged with pink, and are arranged several together to form erect racemes at the ends of the branches. It appears to have been brought from Constantinople to England about the end of the sixteenth or beginning of the seventeenth century. It has been supposed to be a native of Tibet, but it has lately been found apparently wild on the mountains of Greece at an elevation of from 3000 to 4000 feet above the sea-level. The tree grows rapidly, attaining in a short time a height of 60 or even 100 feet, but for this reason the wood is soft, not durable, and fit only for carving or turning. The bark is sometimes used for dyeing yellow and for tanning; it contains a tannin, a yellow body, a resin, and greenish oil. On the Continent the bark of young branches has been used as a substitute for cinchona bark. The seeds contain a large amount of starch, which may readily be extracted, and the bitterness removed by means of an alkaline solution. They form excellent food for cows, sheep, pigs, and when boiled for poultry. When powdered and mixed with flour they make a very strong paste, said to be offensive to vermin.

HORSE-FLESH ORE is a Cornish name for purple copper, BORNITE or Erubescite. It is a mixture of the sulphides of iron and copper, and is of widely varying composition. It derives its name from its speedily tarnishing externally to a purplish-brown shade, often with iridescent colourings.

HORSE-FLY. See FOREST-FLY.

HORSE-GUARDS, a public military establishment, situated in Whitehall Place, Westminster, to which all official communications relating to the British army are transmitted. Here are the offices of the commander-in-chief, quartermaster-general, adjutant-general, &c., and here the commander-in-chief receives all applications relating to the army. The duties of the Horse Guards relate chiefly to the organization and discipline of the army, while the War Office, in Pall Mall, deals with the general administration and accounts.

HORSE-GUARDS, ROYAL, is the third heavy cavalry regiment of the Household Brigade. It has always been a fine corps of heavy cavalry, and has served in numerous important campaigns. The uniform is a steel helmet with plume, a steel cuirass over a blue coat, leather breeches, and top-boots. The horses are black. The regiment, though now seldom sent on foreign service, took part in the campaigns of Marlborough and fought in the Peninsula and at Waterloo, after which it did not leave the United Kingdom again until the Egyptian campaign of 1882. It has always had the reputation of being one of the finest cavalry regiments in Europe. From the colour of the uniform its popular designation is *The Blues.*

HORSE-MACKEREL (*Caranx*) is a genus of fishes belonging to the order Acanthopterygii, forming the type of the family Carangidæ. This genus is distinguished chiefly by the lateral line of the body being furnished with a series of scaly plates; these plates are horizontally keeled, especially on the posterior half of the body, and frequently terminate in a spine or angular projection directed backwards. The rest of the body, which is more or less compressed, is covered with small scales. There are two distinct dorsal fins, and two free spines before the anal fin, while the teeth are very minute. They are found in almost all temperate and tropical seas. Several species inhabit the seas of Europe. They have a general resemblance to the mackerel in form and taste. One species only, the Scad or Horse-mackerel (*Caranx trachurus*), is found along the shores of our island, vast shoals sometimes making their appearance during the spring and summer months. This species has a very wide range, being found in all the temperate coasts of Europe, ranging through the Indian Ocean to New Zealand and the western coasts of America.

HORSE-POWER is a convenient way of measuring energy, as when we speak of an engine of so many horse-power, &c. The theoretical horse may be measured on the C.G.S. system, that universal scientific measurement coupling the *centimetre*, *gramme*, and *second*, recommended by the British Association, and now being increasingly adopted. In this system the unit force, which is a force moving a gramme weight a centimetre distance in a second, is called a *dyne;* and the unit of work is the amount done by a dyne working through a centimetre, and is called an *erg* (Gr. *ergon*, work done). Now, one horse-power does work equal to 7,460,000,000 ergs a second. Another way of looking at it is in foot-pounds, and here one horse-power is equal to 33,000 foot-pounds a minute—that is, a horse-power would raise 33,000 lbs. a foot high in a minute. This is rather a larger value than the continental horse-power of 75 kilogrammetres a second. A kilogrammetre is practically equal to 7¼ foot-pounds; *i.e.* the continental horse-power is not 33,000, but about 32,625 foot-pounds a minute. Continental engines therefore sound rather more powerful than they really are when their power is given in continental horse-power.

HORSE-RADISH (*Cochlearia armoracia*) is a well-known plant belonging to the order CRUCIFERÆ. The stem is herbaceous, growing to a height of 2 feet, with large crenate radical leaves on long stalks, and stem-leaves smaller with scarcely any stalks. The plant grows best in damp places, where its cylindrical root often penetrates to a distance of 3 feet. It may be known from the poisonous aconite root by its acrid odour when scraped, by its form, and its yellowish colour. [See ACONITE.] The horse-radish is cultivated for the sake of its root, which is pungent and stimulating, and is used not only in salads, but also as medicine in cases of dyspepsia and chronic rheumatism. It is propagated by cuttings of the root, taken from the top, an inch or two long, or old roots are cut up into pieces. It is so tenacious of life that almost every inch of the root will grow, and when once established in the ground it is not easily eradicated. The ground should be trenched to the depth of 3 feet and slightly manured. It is a native of the east of Europe, but has been naturalized in various countries. SCURVY-GRASS is another species of Cochlearia.

HORSE-RADISH TREE (*Moringa pterygosperma*) is a tree belonging to the order MORINGEÆ. It is a native of the Western Himalayas and Oude, and is cultivated in various tropical countries. It derives its name from the similarity in form and properties of the root to that of the HORSE-RADISH. The leaves are bipinnate or tripinnate, the flowers white, the fruit a long three-valved pod, and the seeds roundish and three-winged. The timber is of no value, but almost every other part of the tree is used by the natives of the countries where it grows. The root is used internally for paralysis and epilepsy, and externally as a rubefacient for palsy and chronic rheumatism. A gum like tragacanth exudes from the bark, and the wood yields a blue dye. The leaves and flowers are eaten by the natives, and the twigs and leaves can be used as fodder. The unripe pods when plain boiled resemble asparagus, and are also excellent in curries. The seeds are the most valuable part of the tree; they are known as Ben-nut, and yield an excellent oil [see BEN, OIL OF], which keeps for years without becoming rancid.

HORSE-SHOE BAT is the name given to a family of BATS, Rhinolophidæ, from the fact that their noses are furnished with a membranous horseshoe-shaped appendage, which in some species is remarkably complicated. In those instances where this membrane is double, the form of the anterior division is more or less heart-shaped, the posterior division having the aspect of an erect lanceolate leaf with the apex directed towards the forehead. The ears are invariably large, separated from one another, and destitute of the little lobe guarding the internal ear called the *tragus*. Occupying the situation of this latter structure, however, we frequently find a lobed and projecting membrane developed from the base of the outer margin of the ear. There are two incisor teeth in the upper jaw and four in the lower, and one canine and three molars on each side in each jaw; the number of premolars varies, but is usually four in the upper jaw and four or six in the

The Greater Horse-shoe Bat (*Rhinolophus ferrum-equinum*).

lower. The horse-shoe bats are confined to the warm and temperate countries of the Old World. Their food consists generally of insects, but some of the larger species are said to prey on frogs and even small species of bats.

Two species of horse-shoe bats are inhabitants of England. The Greater Horse-shoe Bat (*Rhinolophus ferrum-equinum*) is found in the southern counties. This bat is 2½ inches long, exclusive of the tail; the wings have an expanse of 14 inches. The head is elongated and swollen towards the muzzle; the anterior leaf-like appendage embraces the nostrils, and has the remarkable horse-shoe shape from whence the English name is derived. Between this and the posterior lanceolated appendage there is a cup-shaped cavity surmounted by a sort of overlapping crest. In concealment this bat is only found in the very darkest and most gloomy recesses, where the light of day can gain no access, and where a noiseless solitude reigns supreme. Natural caverns among rocks, or subterranean chambers artificially hewn out in quarries now long ago forsaken, are its loved retreats. From these situations it issues forth to seek its twilight repast on maychafers and their insect associates. The greater horse-shoe bat is also found throughout Southern Europe and Africa, ranging into some parts of Asia. The Lesser Horse-shoe Bat (*Rhinolophus hipposideros*) has a similar range; it is also common in some parts of Ireland. It is slightly smaller than the other species, which it resembles closely in form and habits. One of the principal marks by which this form is distinguished consists in the presence of an additional thread-like nasal appendage placed immediately in front of the ordinary lancet-shaped process which occupies the frontal region. Other genera belonging to this family are Rhinonycteris, Phyllorhina, and Cœlops.

HORSE-TAIL. See EQUISETUM.

HOR'SHAM, a market-town and ex-parliamentary borough of England, in the county of Sussex, on the Adur, in the centre of a fertile and richly-wooded tract, 37¾ miles from London by the South Coast Railway, on which it is an important junction. It consists of two principal streets, crossing each other at right angles, with a central open space, in which stands the court-house, a handsome edifice of stone. The town contains many very good shops and houses. The parish church is Early English in style, with Perpendicular additions, and has a lofty tower surmounted by a spire; it contains some interesting monuments. The whole building was thoroughly restored in 1865, and a handsome painted glass east window inserted. There are two other churches, six chapels, and many charitable endowments for the poor, the chief of which is a grammar-school, founded in 1532, for sixty scholars. It was enlarged in 1857 by the Mercers' Company of London, and accommodation provided for twenty additional boys. The other principal buildings are the market-house, Henty's Bank, the London and County Bank, and the corn exchange. Tanning is the chief branch of manufacture, but there are also a carriage factory and agricultural implement works, and a very extensive nursery, and the town has a good general trade. Horsham is a borough by prescription, and sent two members to the House of Commons from the time of Edward I. till 1832, when the Reform Act deprived it of one. By the Act of 1885 it was finally merged in the county. The area is 10,770 acres, and the population in 1881 was 7831.

HOR'SLEY, SAMUEL, a distinguished prelate of the English Church, successively bishop of St. David, Rochester, and St. Asaph, was born in London in 1733. He was the son of the Rev. John Horsley, who held two rectories. The bishop was educated at Westminster School, from whence he passed to Trinity Hall, Cambridge, and his father resigned to him the rectory of Newington in Surrey.

In 1767 he was elected a fellow of the Royal Society, and became the secretary of that body in 1773. In 1776 he projected a complete and uniform edition of the philosophical works of Sir Isaac Newton. This design was not accomplished till 1784. In 1781 he was appointed archdeacon of St. Albans, and it was a little before that date that he first appeared in the field of theological controversy. The person against whom he chiefly directed his attack was Dr. Joseph Priestley, a minister among the Presbyterian dissenters, who in a series of publications defended the doctrines of philosophical necessity, materialism, and Unitarianism. Dr. Horsley began his attack in 1778 on the question of man's free agency; it was continued in a charge delivered in 1783 to the clergy of his archdeaconry, and in a series of letters which were afterwards collected and published.

The tide of preferment now began to flow in upon him. Thurlow, who was then chancellor, presented him with a prebendal stall in the church of Gloucester. In 1788 he was made bishop of St. David. In 1793 he was translated to Rochester, and in 1802 to St. Asaph. He died 4th October, 1806.

HORTENSE, QUEEN, the mother of the Emperor Napoleon III., was a daughter of Josephine, the wife of Napoleon I., by her first husband Alexandre de Beauharnais. She was born in 1783. Napoleon, who turned all his family to account, found the beauty of his stepdaughter of use. Several marriage-plans having failed, however, he ultimately ordered his brother Louis Napoleon to marry her, though she loved another man (Duroc) and disliked the brother, while on his side he did not care for her and despised her family. Napoleon, then first consul, was deaf to cries and entreaties, and the ill-omened marriage took place in 1802. Louis was made King of Holland by his all-powerful brother. Queen Hortense had three sons. The eldest died at five years of age, and the second in 1831. Charles Louis Napoleon, the third son, born 20th April, 1808, at Paris, eventually became the emperor whose career began with the street butchery of the *coup d'état* and closed with Sedan. Domestic troubles drove Hortense from her husband, who by this time heartily hated her as much as she him. She became very ill in consequence of the death of her eldest son, and was ordered mountain air. She stayed some time in the Pyrenees, and being there joined by her husband returned with him to Paris in 1807. He then went back to Holland, and she never again lived with her ill-mated consort. Hortense at Paris once more regained her former considerable influence with the emperor, her stepfather. The queen was very engaging and much liked, even by those who condemned her conduct. She was a fairly accomplished musician, and wrote a little. Her melody of "Partant pour la Syrie" was for a very long time popular in France, and Napoleon III. used it as a national anthem. When her husband abdicated the throne of Holland he did not attempt to return to his wife. They continued to live apart, always quarrelling over the custody of the children. Although Queen Hortense was not interfered with at the restoration, she repaid the indulgence of the Bourbons by violently welcoming Napoleon on his escape from Elba, so that after his second overthrow it was manifest she could not remain in France. She retired to a chateau at Arenenberg, on the Lake of Constance. She died there in 1837. Madame de Remusat, the intimate friend and companion of Josephine, endeavours very earnestly to restore the queen's character, but gains nothing but credit for her own good-heartedness and simplicity in making the attempt. ("Memoirs of Madame de Remusat," posthumous, English trans., London, 1880.)

HORTEN'SIUS, QUINTUS, born B.C. 114, of an equestrian Roman family, had attained a great reputation as an orator when Cicero made his appearance in the forum. From that time Cicero and Hortensius were considered as professional rivals, but they lived on friendly terms. Later on they were usually engaged together, and

nearly always Hortensius spoke first, yielding the place of honour to Cicero. At the beginning of his book "De Claris Oratoribus" Cicero pays an eloquent tribute of praise to the memory of Hortensius, who was then lately dead. Hortensius was successively quæstor, ædile, prætor, and lastly consul with Q. Cæcilius Metellus Creticus, B.C. 69. He acquired great wealth, which he spent liberally, and yet he bequeathed an ample inheritance to his children. Hortensius died B.C. 50. Cicero ("Brutus," c. 92, 95) has given his opinion of the character of Hortensius as an orator. He was so wonderful a master of the art of arranging his drapery, and used it in his gestures with such consummate grace that when he spoke the court was crowded with actors who came to study him. He preferred the florid, or as it was termed the Asiatic style of oratory, and was never above enforcing his spoken argument by golden dumb pleadings well distributed among the judges. He was most successful in defending the headlong plunderers of the Sullan faction, such as Verres (though he lost his case in that instance), and naturally enough he received heavy fees, which they gladly paid from their large gains made by extortions from the provinces they had governed. With the large fortune thus amassed Hortensius lived a life of easy refined epicureanism. He was far too clever in his art as a voluptuary to give way to sensual excesses, but he gave banquets of the most costly delicacy, he invented roast peacock and other famous dishes, and he laid down vintages by the vineyard-full, so that he left 10,000 casks of Chian wine at his death. He spent enormous sums on pictures too, giving 144,000 sesterces (about £800) for one picture by Cydias, as we know from Pliny. His parks were full of tamed pet animals, his ponds of tamed pet fish. His favourite trees were nourished at certain intervals with wine.

HOR'TICULTURE. See GARDEN.

HOR'TUS SIC'CUS (literally, "a dry garden"), an appellation given to a collection of specimens of plants carefully dried and preserved. See HERBARIUM.

HOSE'A, one of the Hebrew minor prophets, who, according to the inscription of his book, was the son of Beeri, and who delivered his messages during the reigns of Uzziah, Jotham, Ahaz, and Hezekiah, kings of Judah, and of Jeroboam II., king of Israel, *i.e.* between the years 785 and 725 B.C. The tribe of the prophet is quite unknown, and beyond the name of his father nothing is known of his parentage, but it is generally agreed among commentators that he delivered his prophecies in the kingdom of Israel. His book is naturally divided into two parts, the first extending from the commencement to the end of the third chapter, and the second from the beginning of the fourth chapter to the end of the book. In the first part the prophet, from his personal experiences with an unfaithful wife, and from the names he was commanded to give the children she bore him, recognizes and enforces the truths of Israel's unfaithfulness to Jehovah, his righteous anger, and also his forgiving and restoring love. This portion of the book has been a source of great perplexity to commentators, both Jewish and Christian, by some of whom the narrative has been interpreted as being entirely allegorical, by others as only a vision of the prophet, while the critics of the modern school are more inclined to accept it as representing an actual event in the life of the prophet. The second portion of the book portrays the awful moral degradation of the people, and is full of stern denunciations of the prevalent sins of licentiousness, intemperance, violence, falsehood, and idolatry. As the result of these sins the prophet foresees that a terrible judgment is impending over the land, through which the Assyrians should pass, converting it into a desolation, but from the power and love of Jehovah he takes hope that after judgment has done its work there should be a purification and a restoration of the people.

The style and language of the book are to modern readers somewhat obscure, but it is a mine of allusions to the early history and traditions of the nation. Its canonicity has always been admitted, and it is frequently quoted in the New Testament.

HO'SIERY. The principal seat of the hosiery manufacture in England is in the three midland counties of Leicester, Nottingham, and Derby. In the first of these woollen hosiery forms the principal branch of the manufacture, while in Nottinghamshire the material chiefly used is cotton, and in Derbyshire silk goods are mostly made.

The stocking-frame, by means of which this manufacture is carried on, is, next to the common warp and weft loom, the oldest machine in existence applicable to textile fabrics. It was invented about the close of the sixteenth century by the Rev. William Lee, of St. John's College, Cambridge, but a considerable time elapsed before the produce of this frame took the place of the trunk-hose then worn by all who could afford such an article of dress. For this reason Lee settled at Rouen, in Normandy, where his manufacture was carried on under the patronage of Henry IV.; but the assassination of the king and the political troubles brought on by that event caused the abandonment of Lee's establishment, and that gentleman shortly after died in a state of poverty at Paris.

From the period of its first invention the stocking-frame received no considerable improvement until about twenty-five years ago. Frames with a rotary action, and worked by steam-power, were then brought into use at Nottingham, the economy effected in the process of manufacture being very great. The working of a rotary machine impelled by steam-power, in which twelve stockings are made at the same time, only required the attendance of a man and a boy; whereas in the old frame but one stocking could be made at once by a single workman. The cotton branch of the hosiery manufacture differs from the woollen and silk in the relative proportions of the cost of labour as compared with that of the material. In cotton hosiery the cost of labour constitutes the greater part of the value of the goods; while in woollen and in silk goods the proportion is very much smaller.

It is difficult to describe the processes of the hosiery manufacture without the use of many woodcuts, and even then the routine is not well understood without seeing the machines actually at work. Some idea of the capacity of hosiery machinery may, however, be formed when we remember that a knitter with the old knitting-pins could make sixty loops of stocking-leg per minute; that a frame-work knitter can make 5400 per minute: while a self-acting circular machine, of ten heads, which can be attended by one girl, will make 120,000 stitches per minute. The number of loops and interlacings in a web of hosiery is almost incredible; a pair of ladies' fine cotton stockings contain 394,600 stitches.

In its more general application the term hosiery includes gloves, waistcoat pieces, pantaloons, drawers, braces, webs, comforters, caps, jackets, leggings, and various other articles made nearly in the same way as stockings, and of the same material. The processes for worsted, cotton, and silk are nearly analogous, those for silk, however, requiring the greatest care. Ireland has produced some of the finest specimens of hosiery in the world—a dozen pairs of ladies' full-size stockings having been made weighing only 9 oz.

The chief towns occupied with the English hosiery manufacture are Nottingham, Leicester, Hinckley, Loughborough, and Belper; while in Scotland the chief hosiery centre is at Hawick, where there is a large production of Cheviot wool stockings, drawers, and vests.

There are in the United Kingdom hosiery trade about 50,000 workers, a few thousands of whom still work the hand frames. The value of the exports of cotton hosiery in 1883 was £1,171,141, and of woollen hosiery £899,960;

the figures for silk hosiery are not given in the statistical tables. This of course represents but a small proportion of the total manufacture.

HOS'PICES, institutions founded and generally supported by monks as resting-places for travellers on or near the summits of the Alpine passes. The oldest is on the Great St. Bernard, and others are found on the St. Gothard, Mont Cenis, the Simplon, and the Little St. Bernard.

HOS'PITAL (from the French *hôpital*), a place endowed for the reception of the sick or support of infirm persons. Hospitals (of which the word *spital* is a contracted form) intended merely for the relief of poor and indigent persons in England are called ALMS-HOUSES. At an earlier date hospital signified a place of shelter and entertainment for travellers upon the road, more especially for pilgrims. Many of the charitable endowments in England are called hospitals. They are generally incorporated bodies, and often have schools attached to them, in which the children are sometimes boarded as well as educated. The name is, however, now more generally restricted to places for the reception of sick or wounded persons, and such hospitals are very numerous in the United Kingdom. In London the chief exceptions are the Foundling Hospital, for the reception of illegitimate children abandoned by their fathers; Christ's Hospital, an educational establishment, known as the "Bluecoat School"; St. Luke's and Bethlehem Hospitals, for lunatics; the Chelsea Hospital, for the reception of soldiers. Medical and surgical hospitals are established in almost every large town in the kingdom, and in London they are numerous. The oldest, and perhaps even yet the most important, is St. Bartholomew's, founded in 1547; St. Thomas', the new buildings of which, finished in 1871, constitute it the largest hospital in the United Kingdom; and Guy's, opened for the reception of patients in 1725. These are supported by endowments, and are very wealthy; but most other hospitals in London, as well as nearly all in the country, depend mainly upon voluntary contributions for their support. As to the management of their revenues and general superintendence, hospitals are on the same legal footing as other charities.

In addition to their value as a means of relief in disease, hospitals are naturally the very best schools of medicine, and nothing is so certain to secure a physician or surgeon a good private practice as the knowledge that he has considerable hospital experience. Most hospitals are open by night as well as day to receive pressing cases, and there are always a surgeon and assistants in attendance. Visiting physicians, each of whom generally superintends special classes of complaints, also attend daily.

Hospitals for the sick in this country may be divided into four main classes—1, general hospitals; 2, special hospitals; 3, children's hospitals; and 4, class hospitals. General hospitals receive as in-patients or treat as out-patients, according to the urgency and severity of the cases, persons suffering from diseases (with certain exceptions), accidents, injuries, and deformities. Special hospitals receive patients suffering from one class of diseases, as fever, small-pox, cancer, consumption, or dental complaints. Children's hospitals provide accommodation and treatment solely for little children, though several of the general hospitals have for many years had children's wards attached to them. Class hospitals are those set apart for special classes of persons, such as soldiers, seamen, and particular nationalities.

The eight largest hospitals of London administer relief every year to half a million patients. There are at least six other general hospitals, as well as several children's hospitals, a long list of hospitals for special classes and special diseases, and numerous dispensaries; and all are continually beset with applicants for whose admission no place can be found. Many of the patients come from the country, attracted by the great reputation of the medical staff of the metropolitan hospitals, or are sent up by country practitioners.

The period of convalescence from injury or acute illness, which to persons in comfortable circumstances is by no means without its pleasures, is often to the poor a time of great misery and privation, as they generally exchange the good food, careful attendance, and clean open hospital wards for the noxious atmosphere of a crowded court and scanty unwholesome food; while a premature return to perhaps unhealthy employments brings on, while in a weak state, a return of the malady, ending in death. Considerations such as these have led within late years to the establishment of numerous convalescent hospitals and homes. Most of them are by the sea-side, and many of them are specially promoted by ladies' well known for their large-hearted philanthropy. They afford an opportunity to the poor of obtaining that rest, exercise, good living, and change of air and scene of such inestimable value to the perfect recovery of health.

Although the primary design of all these institutions is to afford assistance to persons who are unable to pay for private medical or surgical aid, there is good reason for believing that their benefits are frequently conferred on workmen in receipt of high wages and on their families, who are scarcely to be regarded as proper objects for such charities. Such persons are, when employed, well able to set aside a small sum from their earnings to join a sick club or other provident society to provide for the evil days of sickness; and it is said by competent judges that the indiscriminate manner in which gratuitous medical relief is afforded at the hospitals, more especially in London, only tends to encourage improvidence. In 1880 the authorities of St. Thomas' Hospital decided to try the experiment of "paying wards," in which sick persons are received and nursed at various weekly rates, according to their means. Other hospitals also now receive patients for payment.

During the past few years there has been considerable controversy as to the unhealthiness of large hospitals as compared with private homes. In a paper contributed to the *Edinburgh Medical Journal* in 1869 by Sir James Y. Simpson, a new term, "hospitalism," was introduced to designate a condition of things which the writer described as prevailing wherever a large number of sick or surgical cases were brought together, and which that eminent surgeon regarded as fraught with grave danger to all such patients. In the controversy which this excited many eminent medical authorities have taken part, and the divergence of their views may be briefly indicated by the fact that some of them have declared it to be an open question whether hospitals have not destroyed as many lives as they have saved, while others equally eminent maintain that there is no reason in the nature of things why the largest hospital should not be as healthy as a private sick-room, and that even now hospital practice, all things considered, is as healthy as private practice in similar cases. Probably the truth lies somewhere about halfway between these extreme statements, but the controversy has had excellent results in calling attention to the paramount necessity in all large hospitals for perfect cleanliness in everything connected with the wards and their inmates; for the maintenance of such arrangements for ventilation as will allow of frequent renewals of the air admitted to the wards; and for the most careful attention to minutiæ of surgical treatment and care in the dressing and cleansing of wounds. These matters now receive the utmost consideration from those who are responsible for hospital management, and an increase in the proportion of cases successfully treated has proved the value of the precautions taken.

In Birmingham a very successful practice has for some years existed, of annually making a collection in all the various places of worship, on some Sunday agreed upon, for the benefit of the hospitals. This plan was adopted in

London and other towns in 1873; and in 1874 an "hospital Saturday" was inaugurated in addition, the idea being that operatives in factories and workshops should have an opportunity of contributing.

Hospitals are found in most European countries, the Maison Dieu in Paris being the oldest, and one of the largest and best conducted, in the world.

Within the last few years attention has been given to cottage hospitals, which were first established at Cranleigh, in Surrey, the idea being first suggested by a severe accident in the village. A very large number have since been established in various parts of the country. Most of these institutions encourage self-help by a scale of fees for the patients, varying from 6*d.* to 5*s.* weekly, according to circumstances.

HOS'PITAL GAN'GRENE, a dangerous and fatal malady which attacks the seat of operations, wounds, and open sores. The parts attacked are converted into an ashy, viscid substance, which rapidly extends itself and creates wide destruction of parts. It has always been the plague of crowded hospitals, and during its prevalence the most trifling operations are dangerous. Spacious wards, free ventilation, and extreme cleanliness are the best safeguards; but these do not always avert it.

HOS'PITALLERS, religious confraternities of the middle ages, who bound themselves to provide entertainments (Lat. *hospitia*) for pilgrims. This duty in such times and in such places as the Hospitallers affected involved military discipline. They also took semimonastic vows of poverty, chastity, and obedience. The most famous of them were the Knights Hospitallers of Jerusalem (afterwards called the Knights of St. John at Jerusalem) and the Teutonic Knights. Of these the first were founded in 1048, and soon rivalled in power the Knights Templars (whose office was to protect pilgrims on their road to the Holy Land); but the times were filled with the unseemly jealousies and bickerings of these two powerful orders. While the Hospitallers of St. John still linger on (though in a widely scattered and degenerate condition, their island of Malta lost to them in 1798, and no grand master having been appointed since 1801), the Templars were suppressed by the Council of Vienne in 1312. In England the property of the Templars (such as was not confiscated) was handed over to the Knights of St. John. Long before this, however, their function as Hospitallers had entirely vanished. See JOHN, KNIGHTS OF ST.

The other great order of Knights Hospitallers was the Teutonic Knights. These were by name rivals of the Knights of St. John, for their full title was the Teutonic Knights of St. Mary at Jerusalem. The order never took root, however, in Jerusalem. It was limited to Germans of noble birth, and had as its duties the usual functions of Hospitallers. Its first seat was at Acre, where, indeed, the sufferings of the Christians at the famous siege had called it into existence in 1190. When Jerusalem finally fell the order retreated to Venice, then to the shores of the Vistula, where they won large tracts of land from the heathen, their capital being Marienburg. One of the Brandenburg princes, Albert, being grand-master, availed himself of a period of decline in the order, turned Protestant in 1525, and seized on the territory, converting it into the duchy of East Prussia. Eventually it passed to the electors of Brandenburg, and gave them their title of kings of Prussia in the long run. The Teutonic Knights, thus roughly dispossessed in Prussia, still exist as an honorary institution in Austria, much as the Knights of St. John are yet found in Spain, in Italy, and in Russia. [See TEUTONIC KNIGHTS.] There are and have been many other orders of Hospitallers in the Roman Catholic Church throughout its career, but they have been more truly devoted to the beneficial duties of their profession, and none of them have made any lasting mark.

HOST (Lat. *hostia*, a victim), the name given in the Roman Catholic Church to the consecrated bread used in the sacrament of the eucharist. It is made of fine flour, unleavened, in the form of a wafer, and usually has some device or inscription on it. The Greek Church and Protestants generally use leavened bread for the same purpose. Prostration before the host was enjoined in the Roman Catholic Church in 1201.

HOS'TAGE, one given in pledge for security of performance of conditions. In warfare it is usual, when a town surrenders, for besiegers and besieged to give into each others hands several officers as pledges that both sides will duly carry out the terms agreed upon. Should either party fail the other has the right to put to death or punish in any way the hostages, though it is seldom that any severer measures than ordinary imprisonment are carried out. When the terms of treaty are fulfilled the hostages are exchanged.

HOT SPRINGS are among the secondary phenomena connected with volcanic action. Their temperature varies greatly, but is in general above the normal surrounding temperature. They afford evidence of internal heat, and are most prevalent in volcanic districts, although not confined to such. When removed from active volcanoes the waters probably derive their superior temperature from percolating through some heated volcanic mass beneath.

In England the most noted hot springs are—Bath, which has a temperature of 120° Fahr.; and Buxton, which has a temperature of 82° Fahr.

HOT'BED, a name given by gardeners to a heap of fresh stable litter in a state of fermentation, upon which a glazed box is placed for the cultivation of certain plants requiring heat and moisture in greater quantity than those agents exist in the external air. Formerly hotbeds were more exclusively used for various purposes in horticulture than they now are. This is owing to the perfection to which other means of producing and applying artificial heat have now attained; but still, for the growth of cucumbers and melons, raising seeds of tender annuals, and of other plants, either culinary or ornamental, hotbeds continue to be advantageously employed, as they likewise are for the striking of cuttings.

Hotbeds may be formed of various substances, such as unrotten dung, tan, leaves, or a mixture of these with moist litter; in short, any substance capable of producing and retaining fermentation, and which will admit of being built up so as to support a frame with sashes. The substance, however, that is most generally used is fresh stable dung. The preparation which it requires consists in its being thrown in a heap and also watered, if it contains much dry litter; and as fermentation proceeds, it should be turned two or three times, and mixed thoroughly in the process.

The situation in which hotbeds ought to be formed should be dry, open to the south and well sheltered in every other direction, either by walls backed by high and close-growing trees, or by very close and lofty hedges. Such extensive shelter, though desirable, cannot always be obtained; but some mode should be employed to break the force of sweeping winds. The basis on which the bed is to be formed should be marked out from 4 to 6 inches each way beyond the dimensions of the frame intended to be placed upon it. The bed is then built of successive layers of the prepared materials, each layer being beaten tolerably compact with the fork as it is laid on, to the height of 4 feet in front and 4 feet 9 inches at the back: the sides and ends should be quite perpendicular. The top layer should be as free from litter as possible. When thus finished the frame and lights are placed upon it; as soon as the violence of the fermentation has diminished mould is put in; and when the latter has acquired a proper temperature the plants are introduced. Instead of mould, rotten tan, or leaf mould, or sand is spread over

the surface of the bed when pots containing seeds or cuttings are to be plunged.

As soon as the heat of the bed begins to decline a lining of fresh materials must be applied. This, however, may be composed of substances that have not undergone any previous fermentation, and may consist of fresh stable-dung, merely shaken up as it is placed against the sides of the bed, or of grass mowings, or of leaves, or of a mixture of such substances. It sometimes happens that, notwithstanding every precaution as to its formation, a hotbed will become too hot for plants or seeds that may have been placed above it. In this case the only remedy is to remove the plants until the bed has been remade, with the addition of some materials the fermentation of which is slower and less violent. Gardeners sometimes attempt to avoid the trouble of doing this by piercing the sides of the hotbed with holes for the egress of heat; but this is seldom an effectual remedy for the evil.

HOT'HOUSE, in horticulture, is a structure in which exotic plants are cultivated under circumstances approximating as closely as possible to those under which they naturally exist; or it is used for accelerating the production of flowers and fruits of either indigenous or exotic plants. Hothouses appropriated to the latter purposes are very frequently termed *forcing-houses.*

The principles by which the construction of hothouses must be governed have reference to the three great agents in vegetation—heat, moisture, and light.

With regard to heat the building must provide for a sufficient amount to raise the internal temperature of the house from that of the lowest degree of external air that occurs in this climate to that of the highest which prevails for any length of time in the countries of which the plants intended to be introduced are natives.

Moisture is of very great importance, and a due proportion of it is frequently more difficult to maintain in the atmosphere of the house than heat, and more so under some modes of heating than others. It therefore follows that, as all applications of fire-heat have a tendency to produce too great a degree of dryness, that mode is the best for the growth of plants which allows the greatest quantity of vapour to remain uncondensed in the atmosphere of the house.

Some tribes of exotic plants, natives of the torrid zone, are adapted for existing under a very dry atmosphere. Instead of developing a thin expanded foliage, they form thick succulent masses, which no degree of atmospheric dryness seems to injure. Plants of such a nature necessarily require a dry stove. In tropical countries the air is saturated with moisture during the night, or at least it is but very rarely otherwise in the open air. But if due precautions be not taken, and temperature only is attended to, without regard to moisture, a degree of dryness will prevail at night in hothouses which is double that of the tropics during the day. Artificial heat having therefore this excessive desiccating tendency, the necessity becomes obvious of adopting such modes of construction and heating as will afford the best means not only of supplying but of maintaining moisture; for vapour may be raised till the air of the house is at the point of saturation, and yet causes may operate so as to occasion a speedy condensation and a consequent dryness.

Light cannot be admitted too freely into hothouses. This will appear evident from the circumstance of the most transparent medium that can be used reflecting a great proportion of the sun's rays when they impinge obliquely on its surface. Although this is now generally acknowledged, and although in cloudy weather great advantage will be derived from a roof rendered as transparent as possible, yet the generality of tropical plants do not thrive in bright sunny weather when placed near the glass of a hothouse in this climate, and a screen of netting is necessary.

With regard to the means of supplying artificial heat, the old system of using brick flues has been to a large extent superseded by that of hot water. Hot-water pipes, once fitted up, require no repairs for many years; whereas the brick flues had to be frequently broken up in order to clear out the soot. By hot water the distribution of heat can also be better regulated, and the uniformity of temperature better maintained, than by any other known means. The methods of heating by hot water are various, and steam, forced through pipes, has also been extensively used as a heating agent. With respect to the maintenance of moisture, the hot-water system, in which the pipes are level or nearly so, presents several advantages over other methods of heating.

Various modes of ventilation are in use. Ventilating apparatus should be so contrived as to be effective in preventing excess of heat; but at the same time it should be perfectly at command, so that when requisite it may be employed in the most limited degree. No method should be finally adopted until it is put to the test by trying whether, under any agitation of the external air, a candle will burn steadily inside if placed near the apertures by which the air is admitted when they are closed.

In all forcing-houses tanks should be placed for supplying water of a temperature more suitable to the nature of the vegetation than that from a pump out of doors. Nothing can be more injurious than cold water applied to the roots and tops of tropical plants, or others in a forcing state, under a high temperature. The rain and dews which supply the plants of warm climates cannot be much below the mean temperature of the climate; and if only equal to the minimum, still it would be between 20° and 30° above that of spring-water in Britain.

Hothouses may be classed under four different heads—namely, the dry stove, the damp stove, the bark stove, and the forcing-house.

The *dry stove*, as the name implies, is used for the cultivation of plants which do not require much water, such as the different species of Cactus, some Euphorbias, and other succulents of like habits. The temperature of such a house during the winter months should never exceed 55° Fahr. No water should ever be given at that period, unless the plant shows signs of suffering from want of it. In spring, or early in summer, most of the plants will show an inclination for growth, and then they may be watered about twice a week. During summer fires may be discontinued, and plenty of air given in fine weather.

The *damp stove* requires treatment of an opposite description. Instead of being kept dry its atmosphere should be always excessively humid, except in the winter season, when the sky is generally cloudy and the sun's rays weak. Various methods are adopted to keep the atmosphere in this saturated state. When the house is heated with common smoke-flues the most simple way is to throw water frequently upon them, and also upon the passages and other places from which it will evaporate, and thus surround the plants with a moist atmosphere. It is a very bad plan, but one too often practised, to water at random—giving all the plants almost an equal share, regardless of their different capacities. Some require a very abundant and constant supply, while others will almost live on the atmospheric moisture which surrounds them. Another thing to be attended to in the treatment of this stove is the placing of the plants. They must be regularly looked over, tied up, and kept clear of each other; the gardener elevating some, depressing others, and giving the whole not only enough room, but also a natural appearance. The temperature should be in winter 55° or 60° Fahr.; in spring it may be gradually raised to 70°; and during fine weather, in the middle of summer, fires may be discontinued for about three months, but the thermometer should never be allowed to sink lower than 60°.

The *bark stove*, when it is of large dimensions, consists of a pit in the middle of the house surrounded by a brick wall, leaving as much room round the sides as will form a passage to walk in. The pit is filled with bark (commonly called tan, from its having been used previously by the tanners), and after being allowed to sink a little and ferment, the pots containing the plants are plunged more or less deep, as prudence may suggest. A bark bed is found useful in the cultivation of all those kinds of plants which are grown in the damp stove; orchidaceous plants, for example, succeed admirably in this way. The treatment of it, so far as the temperature, watering, and syringing are concerned, is precisely the same as for the damp stove.

The only other hothouse distinct from those already noticed is the *forcing-house*. See FORCING.

Hothouse plants are peculiarly liable to the attacks of insects. The most common kinds are the green-fly, thrips, red-spider, brown-scale, and mealy-bug. The first of these is easily conquered by fumigating the house with tobacco, or syringing the plants with an infusion of the same substance. The best remedy for the thrips and red-spider is to syringe well and keep the house very moist and warm, as those insects cannot live in excessive moisture; a little of the flour of sulphur shaken upon the leaves will also destroy such pests. The brown-scale and mealy-bug are the worst of all that infest plants in hothouses. Various substances are used to destroy them; but, after all, the best and surest remedy is to wash them off. This is perhaps rather difficult where these intruders are numerous, but after the plants are once clean it is not a difficult matter, with a little attention and diligence, to keep them so.

HOTEL', the term applied to an inn or place of temporary accommodation for travellers. It is derived from the French *hôtel* or *hôtellerie*; but in that country it is not exclusively applied to houses of public accommodation, but is also used to designate the town residence of a great personage, as the word inn in England was once applied to the city residences of distinguished individuals. The inns of ancient times were generally only suited for the humbler classes of travellers, and at many refreshment was gratuitously distributed to poor wayfarers. With the introduction of Christianity the duties of hospitality and the claims of religion for a long period rendered inns unnecessary—more especially when monastic establishments became general. But with the advance of civilization and the consequent increase in the number of travellers, it became desirable to establish places where food and shelter could be procured and paid for as a matter of business. Hence the origin of the modern inn, which, in England especially, soon attained to a position of respectability and importance. A good idea of many of the old London inns is given in "The Curiosities of London," by Timbs; and descriptions of the English inns of the last century are met with in the writings of Johnson, Goldsmith, Fielding, and Smollett. They have also been celebrated in elegant prose by Washington Irving, and in many of Dickens' works there are laments over their departed glories. The great changes effected in travelling by the introduction of railways have resulted in many of the good old-fashioned English inns being converted into or superseded by hotels —buildings of a much more pretentious character. In fact, some of the more recently erected, such as the Grand, Grosvenor, Langham, and Midland, in London, and the Grand Hotel at Brighton, are quite palatial structures, several of them being among the finest buildings in the metropolis. All of those mentioned were built and are managed by companies, and as regards accommodation are at least equal to most of the magnificent continental hotels.

In the United States the hotels or boarding-houses are by some preferred to private houses as places of residence. They are conducted somewhat on the continental plan—*i.e.* the meals are supplied in the *table-d'hôte* style at a common charge, including everything but wines and spirits. Many of them are very splendid establishments, and contain from 180 to 800 rooms each.

The law with respect to English hotels and the liability of innkeepers is laid down in the article INN.

HOTTENTOTS, an aboriginal race of people found chiefly in Cape Colony, but believed to have spread, during their early nomad life, over a great part of the southern table-land to the sea on the west, and to a limit not well defined on the east. They consist of various tribes, as Koranas, hill and lowland Damaras, great and little Namaquas, Griquas, Lehayas, and others. Many of them have been civilized by the various Christian missions, and have adopted a settled way of life. They are usually of low-set, spare forms, of a yellowish pale olive colour, with highly projecting cheek-bones, flat noses, wide nostrils, thick lips, narrow pointed chins, and woolly hair. When the Dutch first settled at the Cape they amounted to about 200,000; but the hard usage which they have met with both from the Dutch boers and their own countrymen have very much thinned their numbers, and also led to intermixtures which have destroyed the purity of their race, and made it almost impossible to recognize their original features. Of those still living in the colony very few understand the Hottentot language; all the rest outside the Christianized families use a kind of Dutch jargon.

The language of the Hottentots is a curious and interesting study; many of the names of animals of the sea, and many other natural objects, are formed from an exact imitation of the cries of the animals, the noise of the waves, &c.; and the pronunciation of a great many of their syllables is attended by various peculiar clicking noises made by suction with the tongue, teeth, and palate, unknown in the mode of speech of any other people, tribal Kafirs excepted, and which it is extremely difficult for anyone but a native to acquire. The click is made to serve for inflexion and emphasis. What was formerly called the country of the Hottentots is now comprised in the northern divisions of Cape Colony.

Hottentot, or Hüttentüt, is Dutch for a quack or a gabbler, and probably is due to the peculiar clicks and snorts above referred to. The savages, however, call themselves *Khoi-Khoi* ("men of men"); and the inferior race, whom we call Bushmen or Bosjesmen, they call *Sâ*, and account them less than dogs. The great authority for these races is the learned Dr. Theophilus Hahn, who was reared among them (and the Zulus), and in a fortunate hour was appointed, by the influence of Sir Bartle Frere, to the chair of philology at the University of Cape Town, a professorship which has the special duty of investigating the native tongues and manners. In 1882 Dr. Hahn published "Tsuni || Goam, an Account of the Supreme Being of the Khoi-Khoi," as yet the most valuable account of these races. (The sign || is an endeavour to indicate the lateral click of the tongue occurring in the Hottentot pronunciation.)

Now although the Khoi-Khoi look down so loftily on the Sâ, Dr. Hahn shows from the structure of their languages that in all probability the two were originally one folk—the Sâ having remained mere hunters, while the Khoi-Khoi have led a pastoral and agricultural life. The degraded Sâ speaks a tongue scarcely intelligible to one of his own kind from a distance, while the Khoi-Khoi dialects differ hardly more among themselves than our own varieties of English. The Khoi-Khoi, the much older type of speech, has monosyllabic roots ending in a vowel, articulation being accomplished by pronominal suffixes. The Sâ dialects, on the contrary, have no such formative elements; their roots are polysyllabic, and their whole tongue seems in violent phonetic decay. Still Dr. Hahn considers that this broken language stands to the more intelligible

tongue of the Khoi-Khoi in quite as close a relation as our modern English to the pure Sanskrit; only that English, though grammatically broken, is a far richer and more powerful speech than its original, while the state of the Bushman's speech is one of decay alone.

The Khoi-Khoi have a very perfect decimal system of numbers; the Bushmen scarcely get beyond two or three, though they have the words in their tongue for higher numbers. The Khoi-Khoi name all the boys after their mother, all the girls after their father. One thing is very extraordinary as an analogy. The special function of milking the cows is reserved for the eldest daughter—she is the milker. Now our word *daughter* is the Greek *thugater* and the Sanskrit *duhitar* (*duh*, to milk), which has precisely the same meaning—that of the milker.

The supreme being of the Hottentots is *Tsuni* || *Goam* or *Tsui* || *Goab*. He is the god of thunder, of lightning, of hail and rain and sunshine, prayed to in every emergency, and relied on with touching confidence in every difficulty, as all trustworthy travellers report. Yet he is only a deified medicine-man, a sort of quack doctor, with a broken knee, we are told (Appleyard, "Kafir Grammar;" Moffat, "Missionary Labours in South Africa," &c.) Dr. Hahn himself has collected much mythology on this extraordinary subject, attributing the sore knee or broken knee to wrestlings with other heavenly powers, which may be compared to Jacob wrestling with the angel, &c., but he also discovered the explanation. The word *Tsui* means now sore or lame, and || *Goab* means knee. But Tsui also means blood-red, and || Goab comes from *goa*, to walk; hence it indicates not only the knee as a great agent in walking, but also has the meaning of the approacher. It is in this sense that *goara* means the dawn, the approaching day. Tsui || Goab, therefore, means blood-red dawn in truth, though the more common meanings of its components make it in every-day speech bear the sense of lame knee. Once let the Supreme Being be called Lame Knee, and stories of course naturally arise to explain the lameness. Let us not, moreover, look lightly on the Blood-red Dawn as a poor name for the Supreme Being; for we have to consider that the Sanskrit *Dyaus*, the Greek *Zeus*, the Latin *Ju*(*piter*), and the French *Dieu* mean simply the bright sky. The enemy of Tsui || Goab is Gaunab, or night, sleep, and death, with whom he wages perpetual strife with alternate victory and defeat.

HOT'TENTOT'S BREAD is the name given at the Cape to a plant also known as Elephant's Foot (*Testudinaria elephantipes*), one of the DIOSCOREACEÆ. This plant is nearly allied to the yams, but the large rounded root-stock is aboveground, and is covered with a thick bark marked with angular projections, which has been likened to the shell of a tortoise, hence the generic name. The large amount of starch contained in the root-stock afforded food to the Hottentots. The stem is slender and climbing, with small leaves and inconspicuous diœcious yellow flowers. This plant was first introduced in 1774; it is occasionally cultivated, and succeeds well in a mixture of turfy loam and peat. When not growing the root-stock should be kept dry.

HOTTO'NIA, a genus of plants belonging to the order PRIMULACEÆ. One species, *Hottonia palustris*, is a native of Great Britain in ponds and ditches, and is called the water-violet. The finely-divided leaves are submerged and grow in tufts; the flowers rising above the water are of a pale pink colour. It is a singularly beautiful plant, and is often cultivated. The genus differs from Primula in having the five valves of the ripe fruit connected at the top as well as at the base.

HOUGHTON-LE-SPRING, a town in Durham which has very much increased and improved of late years. It is 7 miles north-east of Durham, and is in the centre of a very populous district of villages. The inhabitants are chiefly engaged in the neighbouring collieries, but there are also an iron-foundry, several breweries, and brickworks. The town was long the residence of Bernard Gilpin, the Apostle of the North. The population of the parish in 1881 was 28,104; of the town, 6041.

HOUND (German, *hund*) is a term generally applied to dogs of chase, and most strictly to those which follow their prey by the sense of smell. Nevertheless it is popularly applied to such as hunt down game by sight, as the Scottish deerhound and the GREYHOUND or gaze-hound. [See also BEAGLE, BLOODHOUND, HARRIER.] Our ancient breeds of hounds have merged into lighter and swifter races. Of these the FOXHOUND takes the pre-eminence in speed, vigour, and endurance. It is the old southern hound crossed with the greyhound. The stag-hound proper is now extinct, foxhounds being used for stag-hunting. The otter-hound closely resembles the old southern hound. Its coat is thick, rough, and wiry. It is not common, being generally superseded in the sport of otter-hunting by foxhounds.

HOUND is the name given to a genus (Mustelus) of small sharks, one species of which, the Smooth Hound (*Mustelus vulgaris*), occurs on the British coasts. The hounds are bottom fish, living principally on molluscs and crustaceans. The teeth are small, flat, without cusps, and arranged like a mosaic pavement. The first dorsal fin stands nearly midway between the pectorals and the ventrals; the second dorsal is only slightly smaller than the first; the caudal is short and has no pit at its root. The spiracles are small. Five species are known, two of which are European. The British species attains a length of 3 feet; the body is of a gray colour, with small white spots on the upper surface.

HOUND'S-TONGUE. See CYNOGLOSSUM.

HOUR, HOUR-CIRCLE, HOUR-LINE. The first word means the twenty-fourth part of a day, by whatsoever revolution the day may be measured. In angular measure it signifies the twenty-fourth part of a complete measure, or 15 degrees, the entire circle of revolution counting as 360 degrees. The division of the day into hours is very ancient. It was probably known to the Babylonians and Egyptians, and from them derived by the Greeks and Romans. They, however, only confined their division to the natural day—while the sun was above the horizon—which they divided into twelve parts. Consequently the length of the hour constantly varied; but the system, with the addition of a similar division of the night, continued till about the fourth century, when the plan of reckoning twelve hours from midnight to mid-day (a.m.) and from mid-day to midnight (p.m.) was adopted. All European countries commence the day at midnight, and since 1st January, 1885, the day at the Royal Observatory, Greenwich, has been reckoned as from 0 to 24 hours, the previous distinctions of a.m. and p.m. being dispensed with. Astronomers had long been in the habit of using a similar division of the day. The Chinese hour is twice the length of ours, for in China there are but twelve hours for day and night together.

Hour-circle.—Any great circle on the sphere which passes through the two poles is called an hour-circle, because the hour of the day is known when that circle of the kind mentioned is ascertained upon which the sun is for the time being. But the two semicircles into which the poles divide such a circle belong to different hours, and are twelve hours asunder.

The hour-circle of the equatorial telescope is a circle divided into the twenty-four hours of right ascension, and mounted at the lower end of the polar axis. It bears two verniers flush with the graduation. The upper one is fixed to the stand, the lower one turns with the telescope. When the telescope is in the meridian the two coincide. The circle is movable, and is adjusted before the observation,

so that the fixed vernier is true for the local sidereal time, marking the right ascension of the part of the celestial sphere in the meridian. The hour-circle is then carried round by the clockwork of the equatorial, and the movable vernier shows the right ascension of any object which may be upon the cross-wires of the telescope.

The *Hour-lines* of a dial are the lines on which the shadow falls at different hours, and are the intersections of the hour-circles with the plane of the dial. In the times preceding the common use of clocks the science of dialling was of considerable importance, and many works were written on the subject, in which the forms of such instruments were varied without end, as were also the methods of constructing them.

Hour-angle is the astronomical term for the angular distance of a heavenly body from the meridian.

HOUR-GLASS, a glass instrument for measuring intervals of time. It consists of two bulbs of glass, united by a narrow neck, with a hole communicating one with the other. One end is partly filled with fine sand, of sufficient quantity to run through the neck into the other end in a given time—an hour if it is to be an hour-glass, a minute if a minute-glass. Hour-glasses, or at least instruments on the same plan, were formerly much used in churches to check the length of the sermon.

HOUSE. The degree of comfort exhibited in the arrangement of the house is one, and a very important, characteristic of a nation's degree of civilization; and we may mark the progress of this civilization in its successive stages from a rude condition to a high state of perfection by studying the architecture of a people as shown in their ordinary dwellings. For an account of the architecture of the ancients see the articles GREEK ARCHITECTURE and ROMAN ARCHITECTURE.

Three centuries ago English houses were constructed in a very different manner from those of the present century. The chief materials were wood and plaster, and a common but peculiar feature was the projecting upper floors. The internal arrangement was adapted to the wants of that day, and the external architecture had often a picturesque appearance, as was clearly seen in the street of "Old London" carefully reproduced at the Health Exhibition of 1884.

Every convenience which ingenuity can contrive is now found in the numerous minute arrangements and details of English houses, even of those which do not belong to the wealthy class. Those luxuries which the richest nobles could not formerly procure at any price are now at the command of every man of a moderate income. We are, of course, here speaking of really well-built houses; for of late years the demand for "genteel" villa residences in the suburbs of London and other large and prosperous towns has become so great, that speculating builders have been induced to erect houses of the very worst description. They are generally showy, but built only to sell, and mainly of a very unsubstantial character. The houses in the Scotch cities and towns are built in what are called "flats," communicating by a common staircase, and each flat or storey containing accommodation for one or more families.

The houses of the poorer classes are too often negligently built. In their construction economy, convenience, and a wholesome ventilation should be mainly kept in view, and these may be united with as much picturesque beauty as the nature of the materials will admit of without increasing the expense. In cottages of two storeys the upper should be warmed by a flue from the fire in the lower; in order to effect this the vent ought to be carried up the middle, with its sides as thin as possible. In a single cottage of 12 or 14 feet square, the conveniences should consist of a common dwelling-room on the ground-floor and a sleeping apartment on the upper floor, which should be partitioned off to separate the sexes.

The English and Scotch cottages differ in their external appearance and arrangement. The walls of the old English cottage were formed of clay, mud, or turf, kept together and strengthened with upright pieces of wood and with wooden braces; the roof was steeply pitched. In order to keep the walls dry, the eaves of the roof were continued downwards beyond the top of the wall and projected from it. The chimneys, which formed the main strength of the building, were generally carried up singly in one or both ends of the building, and for the most part they projected on the outside of the wall. The roof was covered with straw, reeds, or slate. The front walls being low, the windows were made much longer than high, and the long lintel, or head part of the window, was supported by one or more upright pieces called *munnions* or *mullions*. The frames for the glass revolved on hinges with an upright axis, and were glazed in borders of lead stiffened by cross pieces of wood or iron, called saddle-bars. The best English cottages of recent construction are built of brick and covered with slate. The use of these materials has changed the character of this class of dwellings; and the progress of sanitary knowledge has led to the introduction of numerous improvements in their internal arrangements.

As the French and Italians of the middle classes do not generally live in separate houses like the English, but, like the Scotch middle classes, on floors containing a series of rooms, it follows that the arrangement of their houses differs from that of the English. The staircase, as in public chambers, is common to each floor. The rooms communicate with each other, and generally with a passage or balcony on one side; chimneys are rare, stoves being most commonly used to heat the rooms.

The Spanish houses are very spacious; they have large courts in the interior, and are formed with galleries round the inside of the quadrangular courts; families occupy the separate floors, as in France and Italy. The houses in many parts of Germany approach nearer to the English in their arrangement than do the French and Italian houses. In many places the houses are a framework of wood, and the interstices are filled with unbaked bricks and are plastered with clay. The mode of heating them in Germany and Switzerland is principally by stoves (Ger. *ofen*), which, in the better houses, are so arranged that the servant feeds the fire without entering the apartment which is heated by it.

HOUSE, LEGAL DEFINITION OF. "An Englishman's house is his castle" is a well-known proverb, and the saying is so far true that no house can be legally broken into unless the inmate be charged with a criminal offence. A debtor for whose arrest a warrant has been obtained may shut himself in his house and defy the bailiff as long as he pleases. At all events, under no circumstances must the latter use force to obtain admission; if, however, he can once get in—by any trick or stratagem whatever—he cannot be turned out. In Scotland the law is very different, for there an order may be procured from the Court of "Queen's Keys,' and a man's house forcibly entered for debt alone.

In defending his house against trespassers and thieves a man must use no more force than is necessary, although in extreme cases even killing the intruder is justifiable. The offence of assaulting a man in his own house—which is always looked upon as more serious than a common assault —is in Scotland called *haimsucken* or *hamesucken*, but in England there is no peculiar name to distinguish it from other assaults. For the law relating to housebreaking, see the article on that subject.

HOUSE OF COMMONS and **HOUSE OF LORDS.** See PARLIAMENT.

HOUSEBREAKING and **BURGLARY.** The derivation of the word burglary is uncertain. The offence of burglary at common law is defined to be "a breaking and entering the dwelling-house of another in the night, with

intent to commit some felony within the same, whether such felonious intent be executed or not." By 1 Vict. c. 86, "night-time" is declared to be from nine o'clock in the evening till six o'clock the next morning. By dwelling-house is meant the actual and personal residence of a man. If a dwelling-house is feloniously entered at any other time than in the night-time, the offence is simply housebreaking. Burglary is now only punishable by penal servitude for life, or for not less than three years, or imprisonment for a term not exceeding two years.

In Scotland the term burglary is not a *nomen juris*, but housebreaking is deemed to be the worst aggravation of theft, and is committed whenever the security of a house has been overcome with intent to steal, however mean and fragile the edifice may be, and whether it be a dwelling-house, a stable, an office, &c. It is sufficient to constitute the offence that entrance has been obtained by raising a closed or partly open window, by the use of a false key or the unauthorized use of the true one, but not by entrance by an open window close to the ground, or by a door standing on the latch. Housebreaking with intent to steal is an indictable offence; theft by housebreaking is still capital, but in practice is now restricted to an arbitrary punishment. Where the entry is made by connivance with servants or others within the house, all concerned are guilty of housebreaking.

HOUSE-CARLS of CANUTE the Great may be taken as the first representative of a standing army in England, later on imitated by Henry VII. in his Yeomen of the Guard, and by the 5000 guards which were retained by Charles II. out of the large parliamentary standing force, and thence developed into our present army constitution. Canute's house-carls or *thingmen* were all Danes at first, but as he grew in favour with his new subjects he permitted Englishmen also to enlist. The total force was about 3000, and was kept up avowedly as a nucleus available at any moment for the formation of a large army around it. They were a magnificent picked body, clad in heavy mail, had javelins to hurl at an advancing foe, and carried great two-handed axes for close combat. In pitched battles they were almost invincible, never fearing to meet two against one; but in general warfare they were a somewhat unwieldy force. Harold experienced this in his Welsh expedition in 1063, and armed them in lighter fashion during that campaign, with the best results. The last appearance of the house-carls was at the battle of Senlac (Hastings), and it is most significant that while other parts of Harold's hastily assembled force are spoken of after the battle, not one word exists to show that a single "axe-man" escaped. It is probable that they one and all fought to the death.

HOUSE-FLY. See FLY.

HOUSEHOLD TROOPS are those troops whose especial duty it is to attend the sovereign and to guard the metropolis. These forces comprise three regiments of cavalry, viz. the 1st and 2nd Life Guards and the Royal Horse Guards; and three regiments of Foot Guards, viz. the Grenadier, Coldstream, and Scots Guards.

HOUSE-LEEK or **SEMPERVI'VUM** (Lat., always living, from *semper* and *vivo*, on account of its tenacity of life), a genus of plants belonging to the order CRASSULACEÆ.

The Common House-leek (*Sempervivum tectorum*) was originally a native of Alpine and sub-Alpine regions of Central Europe, but it has now found its way to the tops of old walls and the thatched and tiled roofs of the houses of nearly all the countries of Europe. Its succulent leaves are disposed in rosettes. It is perennial, and flowers in July. This species is remarkable for the change its structure undergoes by cultivation. The common house-leek is used, both internally and externally, as a popular remedy for many diseases. Its general growth on the roofs of houses seems to have arisen from the belief that it had the power of averting the influence of lightning from buildings. On this account it is also sometimes called the Thunder plant.

The Clammy House-leek (*Sempervivum glutinosum*) is a native of Madeira. The fishermen of Madeira are in the habit of using this species to rub their nets, which are, however, previously steeped in an alkaline solution of some kind. They are said to endure as long as if they were tanned.

House-leek is distinguished from its near ally, Stonecrop (Sedum), by having about twice the number of petals and stamens, and by the hypogynous scales being lanciniate.

HOUSE-SPIDER is the name given to two species of SPIDERS, which are commonly found in houses. These two species, *Tegenaria domestica* and *Tegenaria civilis*, belong to the family Agelenidæ. They are both large, long-legged spiders. Their web is placed in the corners formed by roofs, walls, &c.; it is large, of close texture, and more or less horizontal, attached by its edges and strengthened by many fine threads given off to adjacent objects. It communicates with the spider's den, a short tubular cell, open at both ends, and placed in the obscurest corner of the web. Spenser's description applies well to the webs of these spiders:—

"Enwrapped in fowle smoke, and clouds more black than jett."

They are generally adorned with bits of plaster and other rubbish.

The female *Tegenaria domestica* is five-eighths of an inch in length, that of *Tegenaria civilis* is a little less than half an inch; in both cases the male is smaller than his partner. *Tegenaria civilis* is known to moult nine times and to live four years, the female producing many broods. (Staveley, "British Spiders.")

HOUS'SAS, the name of the native police raised and organized by Captain Glover at Lagos. They had long been celebrated on the Gold Coast, but their merits became best known in England in connection with the Ashantee War of 1873. They are fine soldierly men, capable of much hard work, and can be disciplined to a high state of perfection. Houssa is a vast country of the Soudan, or Western Central Africa, watered by the Niger in that part of its course where it is known as the Quorra; and the Houssa language, like French, is a cosmopolitan tongue, in which traders of many countries in Africa are accustomed to converse. The Houssas are Mohammedans in religion, but have retained many pagan customs.

HOVEDEN, ROGER OF, a fine old English chronicler attached to the household of Henry II. in some capacity of treasurer connected with minor abbeys and their royal dues, was also professor of theology at Oxford. His chronicle was chiefly written under Richard of the Lion Heart, and breaks off at the third year of John, 1201. It is in Latin, and is easily accessible—the *Chronica Rogeri de Hovedene* forming part of the magnificent Rolls Series. It is in four vols. 8vo, edited by Professor Stubbs (London, 1871). The first part of Roger's chronicle, beginning with the year 732, is really due to Benedict of Peterborough, under which name the king's treasurer, Bishop Richard Fitz Neal, wrote. It professes to continue and complete Bede's History. Roger of Hoveden is of high value for Henry II.'s time, but for that of Richard and the first years of John he is really admirable. No circumstance is too trivial for his pen, and in this garrulous diffuseness many touches are preserved of priceless worth to us, with which better authors would have disdained to cumber their work.

HOWARD, ADMIRAL CHARLES, son of William, Lord Howard of Effingham, and grandson of Thomas, second duke of Norfolk, was born in 1536. He succeeded to his father's title in 1573. After seeing much service by land and sea, he was appointed in 1585 lord high-admiral of England,

and had the command of the naval preparations made against the Spanish Armada in 1588. He acquitted himself of this most weighty charge with signal prudence, skill, and bravery. In 1596 he was joined with Essex in the expedition against Cadiz. For this service Lord Howard was created Earl of Nottingham. In 1601 he suppressed the ill-concerted rebellion of the Earl of Essex, whom he took into custody. Under the reign of James I. he was employed in several distinguished capacities. He died at the advanced age of eighty-seven, 14th December, 1624.

HOWARD, JOHN, the philanthropist, was born 2nd September, 1726. His father was a London tradesman, who left him in possession of a handsome fortune. In 1756, in a voyage to Lisbon, which he was desirous of seeing immediately after the great earthquake, he was captured by a French privateer. The sufferings which he endured and witnessed during his confinement struck deep into his mind. The impression was renewed in 1773, when, as sheriff of Bedfordshire, he had charge of the prisons of the county. In that year he visited, in two journeys, most of the gaols of England, and accumulated a large mass of information, which, in March, 1774, he laid before the House of Commons. Once actively engaged, he became more and more devoted to this benevolent pursuit, and made many journeys at home and abroad in order to collect information. The first fruit of these labours was a quarto volume, entitled "The State of the Prisons in England and Wales, with some Preliminary Observations, and an Account of some Foreign Prisons" (1777). The House of Commons seconded his views by the introduction of a bill for the establishment of houses of correction. Howard, in 1778 and 1779, made other journeys on the Continent and in Great Britain. The results were published in 1780, in an "Appendix to the State of the Prisons in England and Wales," &c. In 1781 and several succeeding years Howard continued his tours on the Continent, and visited most of the countries of Europe.

He returned to England in 1787, resumed his home tours, and in 1789 published the result of his late inquiries in another important volume, entitled "An Account of the Principal Lazarettos in Europe, &c., with Additional Remarks on the Present State of the Prisons in Great Britain and Ireland." The same summer he renewed his course of foreign travels, meaning to go into Turkey and the East through Russia. He had, however, proceeded no further than the Crimea when a fever, which he himself believed to be infectious, put an end to his life, 20th January, 1790. He was buried at Cherson. The fullest account of Howard's life and labours will be found in the "Memoirs of the Public and Private Life of John Howard," by James Baldwin Brown, published in 1818. See also "Howard, the Philanthropist, and his Friends," by Dr. Stoughton (London, 1884).

HOWE, JOHN, an eminent Puritan divine, was born 17th May, 1630, at Loughborough in Leicestershire, of which parish his father was minister. He was educated first at Cambridge, where he took his degree of B.A., and afterwards at Oxford, where he became a fellow of Magdalen College. He was ordained in 1653, and after being pastor of St. Torrington in Devonshire for several years, he was in 1657 appointed by Cromwell to the office of his domestic chaplain. His conduct in this office was such as to gain him the esteem and respect of even the bitterest enemies of his party. After the Restoration he retired to St. Torrington, but was compelled to resign his living by the Act of Uniformity, and for six years he endured great privation; but in 1669 he became domestic chaplain to Lord Massarene of Antrim Castle, Ireland, with whom he remained six years. He afterwards, in 1676, became pastor of a congregation in Silver Street, London, but was compelled to take refuge on the Continent in 1685, settling as a tutor at Utrecht in 1686, where he had several interviews with the Prince of Orange. He returned to England in 1687, where he died on 2nd April, 1706. His greatest work, entitled "The Good Man the Living Temple of God," was published partly in 1676 and completed 1702. He was also the author of numerous works which for a long time enjoyed a high reputation as theological treatises, but which have now only an historical value. He was a man of pure life and devoted earnestness, large-hearted and tolerant in his theology, a broad and deep thinker, and one who to the refinements of high culture added the social habitudes of a scholar and a gentleman. See "The Life and Character of John Howe, M.A., with an Analysis of his Writings," by Henry Rogers (London, 1836).

HOWE, RICHARD, EARL, the second son of Emanuel Scrope Howe, second Viscount Howe, governor of Barbadoes, was born in 1725. At the age of fourteen he left Eton and joined the *Severn*, one of the squadron which, under the command of Commodore Anson, was sent to make war upon the western coasts of Spanish America. He distinguished himself in the West Indies and on the coast of Africa, which caused his rapid promotion to the rank of captain. On the first of June, 1758, he hoisted his flag in the *Essex* as commodore of the fleet destined to blockade Brest. In the same year he married, and soon afterwards losing his brother Viscount Howe, he succeeded to his title and estate. In 1759 Lord Howe served as second in command to Sir Edward Hawke, when he defeated the French fleet under M. de Conflans. Peace being proclaimed, Howe occupied a seat at the Board of Admiralty for two years, and then filled the important office of treasurer of the navy, and was returned to Parliament for Dartmouth. In October, 1770, he was promoted to be rear-admiral of the Blue, and commander-in-chief in the Mediterranean. On a change of ministers his friends appointed him admiral of the Blue. Lord Keppel having resigned his office, Lord Howe succeeded him as first lord of the admiralty. In three months he was obliged to resign on another change of the ministry, which restored Lord Keppel. At this time he was created Earl Howe. On the 22nd of June, 1790, he was appointed to the command of the Channel fleet. On the 28th and 29th May, and 1st June, 1794, an engagement took place in the Channel between the British and the French fleets, when ten of the enemy's ships were dismasted; seven were taken, three only rejoined the French admiral, and Howe had the glory of towing into Portsmouth six ships of the line.

Lord Howe's health now began to fail; but notwithstanding his infirmities, he consented to go in person to quell the mutinies that had arisen at Portsmouth, Spithead, &c. With his wife and daughter he spent the rest of his life in retirement. He declined a pension. He died on 5th August, 1799.

HOW'ITZER, a piece of ordnance which differs from what is denominated a gun only in its proportions, the ratio of the length of the piece to its diameter being considerably less than that in the latter kind of arm. It may be considered as intermediate between the gun and the mortar, though it is mounted on a gun-carriage. It can be employed to project solid and hollow shot, loaded shells, carcasses, and case shot. Being comparatively a light piece, the charge of powder is small, and consequently the angle of elevation required is high.

The howitzer is used against troops in the field, in the attack of redoubts or villages, and both in the attack and defence of regular fortresses. A small light gun, called the Coehorn howitzer, is also much used for mountain service in India, and some heavy rifled howitzers have been introduced during recent years which promise to be very effective in siege operations.

HOWL'ER (Mycetes) is a genus of American monkeys belonging to the family Cebidæ, remarkable for the tremendous howling noise which the males make. Travellers

in the great South American forests agree that nothing can be more fearful than the nocturnal howlings of these monkeys. It appears that the females do not join in the noise. The structure by which these creatures are enabled to give utterance to sounds apparently so out of all proportion to their size, is of a very curious nature. The two sides or branches of the lower jaw are enormously enlarged, so that they form a pair of bony plates descending vertically from the skull, and, when seen from the side, appear fully as large as the latter. Between these is a rounded bony case, consisting of the central part of the hyoid or tongue-bone, inflated into a thin hollow ball. This receives a membranous pouch, which communicates with the larynx, and it is by the reverberation of the voice in the hollow space thus formed that it acquires the tremendous power to which we have just referred. The howlers are the largest and most robust of the American monkeys. Their jaws are large and powerful and armed with strong teeth, the structure of which indicates their food to be principally of a vegetable nature. Their colour is usually reddish or brown, and they are furnished with a long and well-furred tail, which has the tip naked on the lower surface and is strongly prehensile. The thumbs of the hands are not opposable to the fingers. The brain is small and simple, indicating a low degree of intelligence. In their habits the howlers are dull and morose, their movements are slow, and they live in small parties under the guidance of a chief, who is always an old male. Ten species have been described.

The Red Howler (*Mycetes seniculus*) is a native of Guiana, where it inhabits only the woods in the lower grounds. Its length, to the root of the tail, is usually 22 inches, and the tail is of about the same length. The general colour of the hair is a fine red, brighter on the head and limbs; the face is naked and black.

HRIM'THURSES, the *Frost Giants* of the Norse mythology, were the descendants of the terrible monster the primeval giant Ymir or Orgelmir (seething clay), who rose from out the slime of Ginnungagap, the yawning gulf which existed before time began, so soon as the first warming rays of the creation poured into the abyss from Muspelheim, the home of brightness. The food of these Hrimthurses was the milk of the great cow Andumla. But the cow licked the rocks of salt ice until she had licked them to the shape of a godlike form, which came to life as Buri (producer), and his son Bor (born) married a sister of the Hrimthurses and became the father of the gods or Ases, Odin, Wili, and We.

The new bright rulers of the world made short work with Ymir, whom they flung into the yawning Ginnungagap, which vast though it was his vaster body completely filled. But a deluge of blood flowed from his body, which had burst asunder, and in that deluge all the Hrimthurses were drowned save Bergelmir. He, like a Norse Noah, made himself an ark, and saved himself and his wife by floating therein till the blood had soaked away. Then the pair became the parents of many giants. The Ases on the other hand went on to create Sun and Moon, to make an Earth, Midgard, or Mid-World, an Asgard or Ase-World, and an Utgard or Outer-World, where the giants lived. Their name Thurses means thirsty: and they had another name, Jotuns or the voracious ones, whence Utgard was also called Jotunheim. Then began the long strife between the gods of brightness and the cold giants of frost and icy mist. The Ases were victorious in each encounter, and adventured themselves in Jotunheim again and again, but they always had to return. Though they proved themselves superior to their gigantic foes, yet these were like themselves immortal and could not be permanently brought under.

HUANA'CA. See LLAMA.

HU'BERT DE BURGH was one of those great statesmen who have always arisen in England in hours of need to save their country from danger. His public career began in 1199, when he was chamberlain to King John, and in 1203 we find him governor of Falaise and guardian of the young Arthur. He was seneschal of Poitou in 1214, at the time of John's well-planned attack upon France, and it was he who, after the overthrow of the English army at Bouvines, carried through the treaty at the close of the year. He was one of the barons present at the signing of Magna Carta, 15th June, 1215; and was appointed chief justiciary at that time, a post nearly equivalent to what chancellor afterwards signified. John never intended to keep the charter, and as soon as foreign assistance arrived he dashed tiger-like upon the north of England, and turned back at Berwick, determined to cow into submission the whole of the land. But the barons, regardless of the pope's reiterated excommunications, and seeing no harm in changing one French sovereign for another (for it must be remembered that John could not fairly be called an Englishman, both his father and his mother being French), they invited Louis, the dauphin of France, to become their king. He accepted the crown, and landed in Thanet with an army to make good his claim. Nearly all the south-east submitted, and Louis entered London in triumph (1216). The exception to this submission was the fortress of Dover, intrusted to the brave justiciary, which resolutely stood a siege from the English barons and the French army. John hastened southward, but died at Newark on his road, and Prince Henry at ten years old was King of England. William, earl mareschal, was elected regent, and the barons at once returned to their allegiance. The French were alarmed, and reinforcements were hurriedly sent for; but the fleet conveying them was sighted from Dover, and the brave Hubert hastily collected as many vessels as he could from the Cinque Ports, and fell upon the Frenchmen with such vigour that, notwithstanding their great numerical superiority, they were entirely routed and destroyed. The dauphin at once made a truce at Lambeth, and on payment of a moderate sum for his expenses retired to France. The death of the Earl Mareschal caused Hubert to be elected regent, with the papal legate, Peter des Roches, as a colleague, in 1219. His energy soon brought the refractory barons into submission. Long used to defying the royal authority as wrongly exercised by the tyrant John, they now reduced the kingdom almost to the anarchy of Stephen's time. A notable incident was the memorable siege of Bedford, held, though a royal castle, against the king's army by Faukes de Breauté. He was sheriff of six counties, and held all their six fortresses. The siege lasted two months, and so bitter had the strife grown that during a momentary absence of the regent and his more statesmanlike counsels, the Archbishop Langton seized four-and-twenty knights who had surrendered and hung them all, with as many retainers as could be caught (1224). Gradually the peace of the kingdom returned; the legate was withdrawn, and Hubert de Burgh was sole regent, 1227. The king at his majority raised him to the title of Earl of Kent, and confirmed him in his post of chief justiciary and trusted minister of the kingdom. In this capacity his patriotism was put to a new test; for the pope, engaged in a long struggle with the Emperor Frederick II., sent pressing and extortionate demands to England for money, and it was the Earl of Kent's business to refuse them, and to check the arbitrary encroachments upon the ecclesiastical rights of the crown and of private persons which were attempted by the papal emissaries. Benefices were seized and sold, and the emoluments of many of those that were left were transferred to an absentee Italian clergy. At last England was fairly roused—the papal commissioners were seized and beaten, the bull trodden under foot, and the money they had received taken from them and distributed to the poor. The pope, furious, demanded a strict

inquiry, and it became evident that the Earl of Kent, if he had not incited this rising against papal extortion, had at all events encouraged it by not exercising his authority. Henry III., who had long been angry at the earl's persistent refusal to embark in an ambitious foreign policy to regain the French possessions lost by the king's father, John, took the opportunity to disgrace him. Earl Hubert had provided no transport nor provisions for the king's army at Portsmouth, and a promising invitation from the barons of Normandy had thus been lost. Henry rushed on him with a drawn sword, but had after all his violence to yield to the statesman-like reasoning of the minister. Kent fell deeper and deeper into disgrace, and eventually retired, fearing for his life, to a chapel at Brentwood (1232). The king had him dragged out, and ordered a smith to put fetters on him as a criminal. "I will die," said the smith, to his astonishment, "before I put irons on the man who saved Dover from France." The Bishop of London loudly protested against the violation of sanctuary, and Kent was permitted to re-enter the chapel. Hunger soon made him submit, however, and he was thrown into the Tower. He escaped to Wales by the end of the year, and Henry had the grace to admit him again to favour in 1234, though he never more was permitted to use his great abilities for the benefit of his country. He died at Banstead in 1243.

HUC, EVARISTE REGIS, ABBÉ, a distinguished French traveller and missionary, was born at Toulouse, 1813, and joined the Lazarist fathers, a community specially devoting itself to missionary enterprise, in 1837. In 1839 he took orders, and at once left for China. Here he was so successful that a vicar apostolic was appointed for "Mongolia," and the Abbé Huc, who had gained some knowledge of Tartar dialects, volunteered to extend the field of missionary enterprise westward into the unknown heart of Asia. From 1844 to 1846 therefore he travelled with a fellow-missionary in Tartary and Tibet, reaching H'lassa, the capital of the Grand Lama of Tibet, early in the latter year, after very great dangers and privations. Suspecting some counterplotting against the ascendency of China on the part of these foreigners the Chinese envoy to the Grand Lama demanded their expulsion, which was immediately granted. He arrested them, and sent them off with a Chinese guard to Macao near Hong-Kong—a toilsome southward journey of many months, from the effects of which Father Huc never recovered. A trial of course showed the complete innocence of the missionaries of any political or ulterior object beyond their religious work, and they were sent back to the station in the extreme north of China whence they had started. The Abbé Huc was in such a bad state of health that his return to France was imperative, and he arrived at Toulouse in 1849. Afterwards he lived at Paris, where he wrote in succession "Voyage dans la Tartarie," &c. (1852), "L'Empire Chinois" (1854), and "Le Christianisme en Chine" (1857). He died in 1860. The complete novelty of much of what Father Huc had to tell exposed him to the unjust suspicion of having promulgated "travellers' tales," but subsequent travellers have fully corroborated his accuracy in all important particulars.

HUC'BALD (*Hugbaldus*), one of the pioneers of the modern musical system, was born in 840 and died in 930. More is known of his work than of his life, and even of his work but too little remains. The beginnings of such a complex system as that of our modern music must always have a fascination for anyone fond of tracing the development of the human mind. The musical antiquary De Coussemaker has therefore laid musicians under a debt of gratitude by his "Memoir of Hucbald" (Paris, 1841), where all that can be known is told. He was a Flemish monk, dwelling in the convent of St. Amand in French Flanders, his uncle being prior of the convent. He eventually became master of the school attached to the convent. His great gift for theoretical music and musical method, joined to a wonderful power of imparting what he invented, made him in request till past middle life as an organizer of choirs and music schools. Men were as fond of music then as now, but had little knowledge of how to record or note their conception for repetition. Hucbald's "Enchiridion" (one of the treatises printed in Gerber's collection) lays down the best methods of the time, supplemented with his own inventions. He still bases his scales upon the Greek tetrachord [see GREEK MUSICAL SYSTEM], but in such a way that those hexachord scales readily grew out of it which Guido of Arezzo had the honour of bringing into formal order. See HEXACHORD, GUIDO D'AREZZO.

HUD'DERSFIELD, a municipal and parliamentary borough, on the river Colne, in the West Riding of Yorkshire, is situated 7 miles S.E. from Halifax, 15 miles S. from Bradford, 17 miles S.W. from Leeds, 26 miles N.W. from Sheffield, 26 miles N.E. from Manchester, and 189 N.N.W. from London by the London and North-western Railway. The Holme and the Colne join near the centre of the borough, and 3 miles lower the Colne flows into the Calder. The municipal borough includes the townships of Huddersfield and Lindley, in the parish of Huddersfield; the townships of Almondbury and Lockwood, in the parish of Almondbury; and the township of Dalton, in the parish of Kirkheaton; its population in 1881 was 81,841. The parliamentary borough includes the municipal borough with part of Linthwaite in the parish of Almondbury, and part of Longwood in the parish of Huddersfield. In 1881 its population numbered 87,157 persons; its area is 17 square miles, and the density of its population eight to an acre. The houses, shops, mills, and public buildings are, with very few exceptions, constructed of light coloured local stone; the footways are flagged with local flags, and the streets are mostly paved with sandstone blocks, and in rare instances with granite. The trade of the town is much assisted by the abundance of coal in the vicinity, and formerly derived great advantages from the Ramsden and Huddersfield and Ashton canals, which gave communication east and west, and since has been greatly benefited by good railway accommodation, there being direct lines to the metropolis and the principal manufacturing towns, and good access to all parts of England by means of the Great Northern, Manchester, Sheffield, and Lincolnshire, London and North-western (Manchester and Leeds section opened in 1846, and having four main lines of rails most of the way), and Lancashire and Yorkshire Railways; and local branches to Holmfirth, Meltham, Clayton West (Lancashire and Yorkshire), and Kirkburton (London and North-western). In 1884–85 large additional warehouse, siding, and station accommodation was provided. The canal running west, connecting the town with the Mersey, passes through the chain known as the English Apennines by a tunnel over $3\frac{1}{4}$ miles long, and the range is also pierced by two tunnels on the London and North-western line, 3 miles and 570 yards long, adjacent to the canal tunnel.

The parish church was a small ancient structure, which was taken down in 1835, when a new one was erected in the Perpendicular Gothic style. There are several other churches of the Establishment—all modern—and places of worship for all denominations of nonconformists, the chief of which are those belonging to the Congregationalist, Wesleyan, Free and New Connexion Methodist, Primitive Methodist, and Baptist bodies. The board schools of Huddersfield (fourteen in number) are distinguished for the high standard they maintain, and the other schools and religious and educational societies connected with the town and county are liberally sustained, and some of them are of a very high character. The infirmary is a large and elegant stone building in the Grecian Doric style, erected in 1831, and enlarged in 1880, and in connection with it

there is a spacious convalescent home, in the domestic Gothic style, built in 1871, at Meltham, 5 miles from Huddersfield, and provided with an endowment of £25,000 by the munificence of the late Mr. C. Brook of Enderby, formerly a member of the firm of Jonas Brook Brothers, Meltham Mills. There are medicated and other baths at the infirmary, erected at a cost of £2000, the gift of the late Mr. George Brooke of Springwood Hall. In 1870 a handsome Lombardic building was erected for the Halifax and Huddersfield Union Bank. The town-hall, opened in 1881, and borough offices, opened in 1878, are a fine block of buildings, but somewhat hidden by surrounding buildings. The market-hall, opened in 1880, is a handsome Gothic building. The post-office was built in 1874 by Sir J. W. Ramsden, Bart., M.P., the ground landlord of the town (whose local residence is Longley Hall, in Almondbury), and by him is leased to the government. The Estate Buildings is a highly ornamental edifice near the railway station. The Huddersfield Banking Company opened in 1883 beautiful new offices near the centre of the town, and the West Riding Union, the Yorkshire, and the Halifax joint-stock banks occupy fine erections near the ancient market-place. The other noteworthy edifices include the cloth-hall, a circular building, half a mile in circumference, constructed of brick, and partly used as an exchange and chamber of commerce; the mechanics' institute and technical school (cost £20,000), opened in 1883 by the Duke of Somerset; the armoury (used by the rifle volunteers and the yeomanry), the theatre, the union offices, the town-hall at Lockwood, the fine mechanics' institutions at Lockwood and Lindley, the Victoria Temperance Hall, the large co-operative store built in 1884–85, the public baths in the central district and at Lockwood, the Freemasons' halls in South Parade and Fitzwilliam Street, the savings bank, the Huddersfield Proprietary College, the collegiate school, the block of artisans' dwellings, the county court, the county magistrates court-house, the fire brigade depot, the model lodging-house (corporation property), and the public slaughter-houses. In addition to the institutions already named there are in the borough the literary and scientific, the archæological, the naturalists', the amateur artists', the choral, and the charity organization societies; the industrial home, the church institute, the Young Men's Christian Association; the Huddersfield, the borough, and the working men's clubs; and over a score of political clubs, most of which are also of a social character.

The manufactures comprise broad and narrow cloths, kerseymeres, flushings, serges, cords, pilots, mohair and sealskin cloths, "fancy" woollen and worsted goods, cotton warp, silk spinning, cotton spinning and doubling, and calico printing. With the district of which it is the centre, the town ranks next to Leeds in the production of woollen and mixed fabrics, and in variety it surpasses every other place in the woollen districts. The factories are chiefly outside the town, which is the centre and market to which most of the produce of the neighbourhood is brought for the purpose of being sold. In addition to its cloth manufacture, Huddersfield also contains engine and boiler factories, machine shops, dye-houses, chemical works, and three organ manufactories.

The town has wonderfully improved in recent years: two new bridges have been built over the Colne, a dozen miles of tramways constructed and worked by steam-engines, new streets have been laid out, many fine buildings erected, and the new warehouses, banks, and other houses of business may fairly rank with those of any other provincial town in England. In fact, the town has been justly described as one of the most beautifully situated, clean, and prosperous manufacturing towns in the kingdom. A statue of the late Sir Robert Peel was erected in St. George's Square in 1873. There is in Lockwood ward a park of 21 acres named Beaumont Park, after Mr. H. F. Beaumont, of Whitley Beaumont, who gave the land, upon which the corporation has expended about £25,000; and another park half a mile from the centre of the borough, named Greenhead Park, containing 30 acres, bought from Sir J. W. Ramsden, who returned £5000 of the purchase money, and upon which the corporation has spent in all £60,000. Greenhead Park was opened by the then mayor (Alderman Wright Mellor) in 1884, and Beaumont Park in 1883, by his royal Highness the late Prince Leopold, duke of Albany. Huddersfield was created a parliamentary borough in 1832, and then consisted of the township, but by the operation of the Reform Act in 1867 it was enlarged. The number of registered electors in 1884 was 14,518.

The town from 1849 to 1868 was governed by improvement commissioners. In 1868 it was incorporated as a municipal borough, and adjacent townships, as previously named, were included. The borough is divided into twelve wards—two of them double wards, and there are fourteen aldermen and forty-two councillors. The corporation possesses the gas-works, which cost £147,000, and in 1884 introduced improved lamps for the main streets. The water-works, which have cost £750,000, are also in the hands of the corporation. There are five storage reservoirs, the highest 1200 feet above sea-level, on the moors between Huddersfield and Saddleworth, and combined they are capable of holding 900,000,000 gallons of water; the largest, at Blackmoorfoot, has an area of 100 acres. The corporation supplies out-districts with water—in all a population of 180,000 persons. In addition to the gas and water works the corporation has under its control the tramways (cost £30,000), the retail and wholesale markets, a block of artisans' dwellings, the model lodging-house (built in 1854, enlarged in 1879), the fair ground, the cattle market, the slaughter-houses, a large sanitary depot, the fire brigade, an hospital at Birkby, and a cemetery, constructed in 1855 and enlarged in 1884.

Huddersfield is said to be identical with the *Oderfelt* of Domesday Book, and to have been at that time a mere waste; but, however this may be, one portion of the present borough has certainly considerable claims to antiquity, and that is the village of Almondbury, adjacent to the Castle Hill, a noble eminence from the summit of which a splendid view can be obtained of the town. The parish is also said to have been separated from Dewsbury and erected into an independent parish by the influence of one of the Lacy family, to whose piety and munificence as the founders of its parish churches this neighbourhood has been greatly indebted. The manor of Huddersfield, which originally belonged to the Earls of Halifax, came into the possession of the Burton family, who sold it in the time of Elizabeth to Sir Gilbert Gerard. How soon the Ramsden family, its present possessors, acquired it is uncertain; but one of them applied, as lord of the manor, during the reign of Charles II., for the privilege of holding a market in the small town of Huddersfield, confirming and adding to a charter of Elizabeth; from this time forward it has been a market-town, but the market rights were purchased from Sir J. W. Ramsden, Bart., and are now held by the corporation.

HUD'SON, HENRY, is eminent among those early navigators who sought a shorter passage to China than the circuitous route round the Cape of Good Hope. After three unsuccessful voyages he undertook a fourth, in hopes of discovering a north-western passage, in April, 1610. In the course of June and July he sailed through the strait, and discovered the bay, both of which have since been called after his name. [See HUDSON BAY.] The insufficiency of provisions exposed him and his companions to great hardship, and at last proved fatal to his scheme. The men became discontented and insubordinate, and while they were in the strait on the voyage home, some of the

boldest of the mutineers seized the captain and eight of his stanchest followers, and sent them adrift in an open boat. They were never afterwards heard of.

HUDSON, a river of the United States of America, upon the shores of which the city of New York stands, is formed by the union of two small streams, each about 40 miles long, which rise in the Adirondack Mountains, in the northern part of New York state. The course thereafter is first south by east, then east, and then due south to New York Bay; length, 300 miles. Below Albany the breadth is from 300 to 900 yards; in one part, however, it expands into a basin 4 or 5 miles wide for a distance of 10 or 12 miles. The largest vessels can ascend to Hudson City, 117 miles, and schooners to Troy, at the head of the tideway, a distance of 166 miles. It has communication with Lake Erie by the Erie Canal, and with Lake Champlain and the Delaware River by the Delaware Canal, and owing to its position and its depth it is one of the most important waterways in the world. The scenery is highly picturesque, indeed sublime in parts, especially at the passage of the highlands 52 miles above New York; it has been compared to that of the Rhine, but is certainly superior. About 30 miles below the passage of the highlands, and 22 miles above New York, the west shore begins to be lined with fine ranges of columnar basalt, called the *Palisades*, which continue for 18 or 20 miles. Upon this river, in 1807, Robert Fulton made the first successful attempt to propel vessels by steam.

HUD'SON BAY is an extensive gulf on the eastern side of North America, and connected with the Atlantic Ocean by Hudson Strait. Its length is 850 miles (between 51° and 66° N. lat.) It is 600 miles across in its widest part. The southern portion, called James Bay, extends nearly 240 miles, and at its mouth (near 55° N. lat.), between Cape Jones, east, and Cape Henrietta Maria, west, it is 140 miles wide. The coasts are generally high, rocky, and rugged, and in many places precipitous, except along the south-western shores between Cape Henrietta Maria and Cape Churchill, where they are low and swampy, and frequently exhibit extensive strands. The depth of water in the middle of the bay has been taken at 150 fathoms, but it is probably greater. In the northern part lies Southampton Island, at the mouth of the strait. The shores of the bay possess an inhospitable climate, being very much colder than places in Scotland in the same latitude. At Fort York, near the western shore, in lat. 57° 2′ N., the thermometer sometimes descends to 50° below zero; brandy freezes to a solid substance in rooms with a constant fire; and but for supplies obtained from more temperate regions existence would be impossible.

Numerous rivers run into Hudson Bay, the largest being the Nelson. The Hudson Bay Company have various "ports," or settlements on its shores. It was discovered in 1517 by Sebastian Cabot.

HUD'SON BAY COMPANY was incorporated by Charles II. under a royal charter dated the 2nd of May, 1670. The charter was given in favour of Prince Rupert, who was the first governor, the Duke of Albemarle, Earl Craven, Lord Arlington, Lord Ashley, Sir John Robinson, Sir Robert Vyner, Sir Peter Colleton, Sir Edward Hungerford, and others; and it states that these parties having at their own great cost and charges undertaken an expedition to Hudson Bay, for the discovery of a new passage into the South Sea, and for finding some trade in furs, minerals, and other commodities, had "already made such discoveries as to encourage them to proceed further in their design, by means whereof there may probably arise great advantage to us and our kingdom." With this view the charter granted to the company in perpetuity the sole trade and commerce of all those seas, straits, bays, creeks, and sounds, in whatever latitude they might be, that lay within the entrance of Hudson Strait, together with all the lands and territories upon the countries, coasts, and confines of the seas, bays, &c., aforesaid. The company thus obtained the privilege of exclusively trading with the Indians in the vast and not well-defined region called Rupert's Land, which comprised all the country that had rivers flowing into the great inlet from which the company takes its name. This association founded several establishments, and has ever since prosecuted the trade under the direction of a governor and committee of management, chosen from among the proprietors of the joint-stock, and resident in London. The company's charter not being confirmed by Act of Parliament, it was considered that all British subjects were entitled to engage in the trade with those regions; and in conformity with this notion the North-west Company was formed in 1783, and proved a powerful competitor. This company had a settlement, called Fort Chippewan, so far west as the Lake of the Hills, in 110° 26′ W. lon.; and some of the Indians trading with them came from beyond the Rocky Mountains. A great degree of jealousy and hostility arose between the respective agents of the two companies, which more or less impeded the operations of both for many years, until in 1821 a junction of the two was effected, and the trade has since been prosecuted peacefully and successfully. The company send out yearly large quantities of blankets, cloth, guns, ammunition, knives, and miscellaneous articles, of which about one-third is for the use of their servants and two-thirds for barter to the Indians for furs.

In 1825 a license of exclusive trade with the Indians, over all that portion of the north-west territory not included in the charter, was granted to the company for twenty-one years. This license was renewed in 1835. The power of the company was thus greatly increased, and all the Indian territories opened to the operations of the association, which now virtually ruled through seventy-five degrees of longitude, from Davis Strait to Mount St. Elias; and through twenty-eight degrees of latitude, from the mouth of the Mackenzie to the borders of California. This extensive tract of country was, however, gradually brought under the pale of civilization; and the company, though retaining its commercial supremacy, lost much of the legal monopoly. The state of Oregon was given up to the United States in 1841; in 1859 the island of Vancouver, and likewise the district of British Columbia, were colonized, and the license withdrawn from the company. Still, in 1863, the company claimed no less than 1,400,000 square miles, or 896,000,000 acres of territory, watered by 1400 miles of lakes and navigable rivers; and on the strength of that claim, more than 150 times the area of Great Britain, they obtained a large increase of capital from new shareholders, and in reality converted the enterprise into a kind of limited liability company. In 1869, however, an end was finally put to that pernicious state of things, by which vast regions of the earth's surface had been so long purposely kept out of cultivation in order that fur-bearing animals might be plentiful. Reliable travellers had ascertained that the almost unpeopled region beyond and north-west of the Canadian lakes, claimed by the company, although the claim was disputed by Canada, contained a magnificent tract of country known as the "fertile belt," stretching 1000 miles in length by 200 wide, in the direct route between Lake Superior and British Columbia—well fitted for a railway, bounded on either side by luxurious corn and agricultural land, and admirably suited for the home of a numerous and flourishing people. But this was impossible so long as the region belonged to a fur-hunting company, who necessarily cared much more for a good supply of beaver, racoon, musquash, otter, nutria, and chinchilla skins, than they did for colonization by human beings. After the confederation of the North American colonies, in 1867, it became more than ever desirable that this state of things should cease; and in 1868 an Act was passed enabling

the crown to obtain territory from the Hudson Bay Company, and add it to the Dominion of Canada. In the following year Lord Granville, who was then colonial secretary, drew up a plan for carrying the Act into effect, which was ultimately agreed to by the shareholders, although their original claim had been for more than three times the amount. The chief terms of the agreement were:—1. The Hudson Bay Company to surrender to her Majesty all the rights of government, property, &c., in Rupert's Land, and also all similar rights in any other part of British North America not comprised in Rupert's Land, Canada, or British Columbia. 2. Canada to pay to the Company £300,000 on Rupert's Land being transferred to her dominion. 3. The company to have the power to select a block of land adjoining each of its stations, but the aggregate extent of the blocks not to exceed 50,000 acres. 4. The company may, for fifty years after the surrender, claim in any township or district within the fertile belt, in which land is set out for settlement, grants of land not exceeding one-twentieth part of the land so set out—the blocks so granted to be determined by lot, and the Hudson Bay Company to pay a ratable share of the survey expenses. 5. The company to be at liberty to carry on its trade without hindrance or any exceptional tax. The money was paid and the transfer to Canada effected in 1870.

HUDSON STRAIT is a channel connecting Hudson Bay to the ocean and to Davis Strait. It is 450 miles long, and has a general breadth of 100 miles. Here Henry Hudson was sent adrift in an open boat by his mutinous crew, with eight companions who were faithful to him, a bag of meal, a flint and steel, and firewood, but was never heard of after.

HUÉ or **HUÉ-FO,** the capital city of the Empire of Anam, Cochin-China, on the Hué River, about 10 miles from its mouth, in the China Sea. The population is not correctly known, but is supposed to be about 100,000. It has no parallel in the East, having been regularly fortified in the European style early in the present century. Its walls, mounting numerous cannon, are upwards of 5 miles in circumference, and inclose an inner citadel, with the palace and spacious barracks, large public granaries, an arsenal and magazines, which, with other public buildings, are supplied with water by numerous canals, faced with masonry, and crossed by fine bridges. A garrison and fleet of galleys are usually stationed here.

HUE AND CRY was the old common-law process of pursuing with horn and voice all felons and such as had dangerously wounded another. This process may still be used in England as a means of arresting felons without the warrants of a justice of the peace. Hue and cry may be raised either by the precept of a justice of the peace, or by a private person who knows of the felony, who should acquaint the constable with the circumstances and the person of the felon; if the constable is absent, hue and cry may be made without license. When hue and cry is raised, all persons are bound to join in the pursuit and assist in the capture of the felon. A constable also, who has a warrant against a felon, may follow him by hue and cry into a different county from that in which the warrant was granted, without having the warrant backed. The pursuers are justified in breaking the outer door of the house where the offender actually is, and are not liable to any punishment or suit if it should appear that the hue and cry was raised by mistake; but the person raising the hue and cry wantonly and maliciously may be severely punished as a disturber of the public peace.

HUEL'VA, a seaport in the south of Spain, capital of the province of Huelva, is situated at the confluence of the Odiel and the Tinto, 68 miles W.S.W. of Seville, with which place it was connected by railway in 1875. It has a good transit trade with Cadiz and Seville, and exports large quantities of fruit, copper, and manganese to England and France. The rich lodes of copper ore in the neighbouring mountains have long been a source of prosperity and commercial importance to the town and province of Huelva. The population is 10,000.

HU'GO, VICTOR, the most distinguished poet of modern France, a viscount of the old French noblesse for all his stern republicanism, was born at Besançon, 26th February, 1802. His full name was Victor Marie Hugo, but the second name is as little used as the title. His father was a colonel in the republican army, and afterwards became a devoted adherent of Napoleon, and was at the time of Victor's birth commandant of Besançon; but his mother was from the country of Georges Cadoudal, that poetical land of La Vendée, where the glamour of loyalty covered all the cruel memories of the by-gone days of monarchy, and her illustrious son held her royalist principles during all his early life. As his father's successive commands required, the child was dragged here and there across Europe. Men and things flitted before him as in a kaleidoscope—by five years of age he had already lived in Elba, in Rome, in Naples, and in Paris; and the fall of King Joseph drove him later on from Spain into France, as a boy of eleven. In 1809 he was sent to a seminary, and received a tolerably sound classical education at the hands of the priests—he whose future life was to be a warfare against priestcraft. Yet, as it has happened with Renan, so with Victor Hugo; no one has had a truer sympathy with the religious sentiment in spite of outward rebellions—the early training has become an ineffaceable part of the mind, though it may be dimmed or clouded over. Afterwards the young man was sent to the École Polytechnique by his father, who wished him to adopt the military profession—a remarkable beginning for Hugo, whose detestation of war was almost phenomenal.

Victor Hugo's poetic power could not long be hidden, and when but twenty he astonished the world by his "Odes and Ballads," and some tales of striking merit, the best of them being "Bug-Jargal," a still deeply interesting romance of negro life, containing pictures which clearly foreshadow the weird terrors of "Notre Dame" and of the "Travailleurs de la Mer." By 1826 another set of "Odes" showed the young poet was fast changing his methods and opinions, and choosing strange metres and subjects which correct writers eschewed; and in 1829 the "Dernier Jour d'un Condamné" made men feel there was a new power in literature of the first rank. Although but in his twenty-seventh year, Victor Hugo now inaugurated the "romantic" movement which he has led to such wonderful success, and which has remodelled the literature of France. He and those who thought with him determined to do away with all the stilted and lifeless rhodomontade of the older tragedy, all the regular cadence of monotonous verses, all the rigid decorum which turned stage-poetry into a combination of a pageant and a prolonged recitation—in fact to strike off those fetters into which the laurels of the great Corneille and Racine had stiffened. First, there were no Corneilles nor Racines to be had; secondly, the nineteenth century could not express itself by the rhythms and methods of the seventeenth. Vigorous action, language of the time, study of nature, blending of the grotesque and even ridiculous with the tragic, such as we find it actually occurring in our real lives, these were the aims of Victor Hugo and his friends. They went too far, of course, in the opposite direction. The crushing down had been forcible, the rebound was equally forcible. Yet reading now the drama round which, as round a royal banner, the main fight was waged, the glorious play of "Hernani" which Victor Hugo produced at the Théâtre Français on 26th February, 1830, we cannot discover, try as we will, why such a piece should have roused such wild animosity and rage in its opponents. The delight of its admirers can be

readily imagined; but why the production of this play should be the occasion of an absolute riot, and why the Academy should actually petition the king himself (Charles X.) to forbid it, are matters of the time which are no longer explicable. Charles X. had the good sense to say that the Academy had forgotten that in matters of art he had no more authority than any private gentleman. In the stirring days of July, 1830, a new success was gained with "Marion Delorme;" and the poet's masterpiece as a novel, the splendidly original "Notre Dame de Paris," brought unmixed triumph in 1831. Another *furore* was made with the magnificent satire of "Le Roi s'amuse" in January, 1832. This was too much. Richelieu had been attacked in "Marion," but here was a king himself (Francis I.) put upon the stage and treated with but little mercy for his crimes. The government of Louis Philippe interdicted the play the day after its production. All was in vain. Victor Hugo was stronger and more permanent than the government of the citizen king, and "Lucrèce Borgia," "Marie Tudor," and other dramas rapidly succeeded each other. His "Feuilles d'Automne," "Chants du Crépuscule" (a title happily imitated in Mr. Swinburne's "Songs before Sunrise"), and other volumes of lyrics quite unrivalled in French literature, also mark this period of splendid creative ability, and were rapturously received; and even the Academy itself, which had so persecuted his "Hernani," and which had invoked Charles X. against him, threw open its jealous portals to receive him in 1841. His popularity was at this time as unbounded as it became again towards the close of his honoured life. The early "legitimate" views derived from his mother had vanished, and he seemed inclined to accept the current order of things. The king, already uneasy, sought to help his waning power by attaching Victor Hugo to himself, and created him a peer of France in 1845. At the Revolution of 1848 he was nevertheless found foremost in the popular ranks, and was elected enthusiastically by Paris to the Constituent Assembly and afterwards to the Legislative. In 1849 he served as President of the Peace Congress, of which he was a leading member. He soon saw through the pinchbeck ambition of the prince-president (Louis Napoleon Bonaparte), to become as near as might be an imitator of his uncle and namesake, and with his great popularity and his splendid presence, his incorruptible rectitude and his fiery oratory, he was a formidable opponent. But though the president's schemes were unmasked as fast as made by his unwearied foes, affairs moved more rapidly and decisively than they dreamed, and the *coup d'etat* took them by surprise on the fatal 2nd of December, 1851. Victor Hugo has narrated this "History of a Crime"—the *coup d'etat* of the 2nd and the street murders of the 3rd and 4th—in his own inimitable way, possibly a little overstating his case, it is true, but blasting for ever the memory of the chief criminal, and showing the meanness and treachery of the reckless band of adventurers who seized France and gagged her for eighteen years till she sank into the humiliation of Sedan. This scorching exposure was the work of years; it contained the hatred of a lifetime; but it was not actually written down and published till 1877–78, a remarkable effort for a man of seventy-six.

Victor Hugo was among the first victims of the treachery of the prince-president in December, 1851, suffering his prison-humiliation, his mock trial, his exile like the rest. All that France had of illustrious, of noble, of patriotic, was torn from her and thrown on foreign shores. Hugo took asylum under the noble flag which is the first refuge of the oppressed. He preferred to live in those Norman islands which remain to remind us of our long-lost Norman territories, and he made himself a home first in Jersey and finally in Guernsey. Not to despair, however; far from it. He seemed to feel that deception could not last, and though the years rolled on he continued his firm contemptuous attitude towards the man who had so gained the crown of France. In 1852 he issued a veritable whip of scorpions in prose, the really terrible "Napoleon the Little," showing the mere parody of the first Napoleon (Napoleon the Great) which this man was. One wonders that a man, even of the Dutch phlegm of the son of Queen Hortense, could read it and afterwards hold up his head. In 1853 the poet followed on the same line with the "Châtiments" in his own varied and stormy verse. "Les Contemplations" returned more to the style of his four Parisian volumes of the earlier time. In 1859 his most perfect achievement in lyric poetry was attained in the "Légende des Siècles," a marvellous series of narrative or pictorial poems, representing scenes from different epochs of the history of the world. The "Châtiments," the "Contemplations," and the "Légende," taken together, may safely be trusted to preserve Victor Hugo's fame as one of the most consummate masters of the poetic art who ever existed. Scornful scathing denunciations of the wrong, tender pleadings for the right, majesty, pathos, simple musical rhythms or the grandest effects of language, plaintive verses or tunes stirring the imagination like the sound of a trumpet, are all to be found in this unequalled trilogy.

An amnesty had invited him to return to France in 1859. He treated it as the insult that it was. But as soon as the second empire had crumbled away of its own rottenness in the presence of Germany, in 1870, Victor Hugo sprang from his retreat, hurried into the thick of affairs, became once more a considerable political power, and was elected, by overwhelming majorities, deputy in the Bordeaux Parliament. The barefaced monarchical intrigues disgusted him, however—his ardent republicanism and democracy were even the subject of ridicule—and he retired disheartened to Brussels. During this temporary second exile he published at Luxemburg (the Belgian government having in alarm requested him to leave their country) the volume called "L'Année Terrible," suggested by the bitter thoughts which 1870 had caused to rankle in the great poet's brain. The Communist rebellion, and the terrible revenge that the maddened bourgeoisie exacted after their victory, brought Victor Hugo again into France. Always on the side of the oppressed and of the people, he begged for the lives of the misguided Communists; but passion ran too high and his noble pleadings were set aside, not very gently. It was probably the deep consideration of the wretchedness of the people which had produced his voluminous novel "Les Miserables" (1862), which is in point of fact a treatise on our social system under the guise of a romance. It is unequal, but magically beautiful in parts. The altogether perfect romance of the poor fisher folk, "Les Travailleurs de la Mer," succeeded it. A curious novel on a partly English subject, "L'Homme qui rit," marked 1869. His last novel, "Quatre Vingt Treize" ("The Year 1793"), often fully equal to its predecessors, appeared in 1874. A second series (two vols.) of "La Légende des Siècles" was published in 1877, of which it is not too much to say that they almost rival the splendid work of 1859 in all except vigour.

Victor Hugo died at Paris in May, 1885, and his remains were deposited with great pomp in the Pantheon. With all his exuberance of declamation, his great affectation and vanity, his want of humour, his almost blindness to logic and philosophy, his frequently false taste, his intentional neglect of smoothness, and his preference of the bizarre and grotesque to the purely artistic, Victor Hugo remains a dazzling figure, a poet of irresistible force, whose verses simply enthrall and transport the reader—not only the foremost French writer of the nineteenth century, but we may say the greatest of French poets; and the homage, amounting to veneration, amid which his last years were spent embrace practically the whole world of letters.

HU'GUENOTS, the name given to the early adherents of the Reformation in France. The origin of the word has been variously accounted for, but it was most probably introduced from Germany as a corruption of the German-Swiss *Eidgenossen*, confederates, or those bound together by an oath. Like many other names it was first given by opponents as a badge of reproach, and subsequently became honourable from its associations. The movement of the Reformation made its appearance in France at the beginning of the sixteenth century; and at the period when Luther was defending its principles before the Diet of Worms, Briconnet, bishop of Meaux, Lefevre, and Farel were labouring zealously for the same cause in France. At first the new doctrines, which seemed to be chiefly directed against the more open sins and derelictions of the clergy, enjoyed the toleration of the king, Francis I.; and his sister Margaret of Valois, the queen of Navarre, was an active supporter of the cause. As it progressed however, the alarm and anger of the clergy became fully aroused, and as some of its manifestations had given offence to the king, a determined effort was made to extirpate it by means of fire and sword. In 1535 a solemn procession in vindication of the faith was made at Paris, in which the king walked bareheaded and bearing a taper; as part of the proceedings six Lutherans were burned, having their tongues cut out and being affixed to a movable gallows, which alternately rose and fell over a fire kindled beneath. This was followed by many executions of a similar kind, and by the more wholesale slaughters which exterminated the Vaudois of Provence; but in spite of these persecutions the number of those who adopted the principles of the Reformation continually increased. Under the influence of CALVIN, who took very great interest in the work of the Reformation in France, the French Protestants about the middle of the sixteenth century began to organize themselves into churches, and to unite these churches into groups or districts for the purposes of mutual aid and counsel. The first French Protestant church was established at Paris in 1555, and very soon afterwards others were established in most of the large towns where the principles of the Reformation had obtained followers. These churches were established according to the Presbyterian form, a pastor being appointed as the leader, with elders and deacons to assist in the government and worship, each church being independent of the rest, though several churches might combine in any movement for their mutual benefit or for the promotion of their common cause. The first synod of the reformed churches was held at Paris in 1559. At this assembly, to which eleven churches sent deputies, a confession of faith and a series of articles of discipline were drawn up and issued, and these, with a few alterations, became subsequently the doctrinal and ecclesiastical standards of the Protestants of France. It is not easy to estimate the number of the Huguenots at this period, but according to Beza they were not less than 400,000, and the party included about one-third of the nobility of France. The persecutions of the Roman Catholic party, however, had become more fierce and intolerable as the number of the Protestants increased, and at last, driven to desperation, the Huguenots took up arms in their own defence and sought to change the government in order that they might gain liberty of worship. In February, 1560, at a meeting at Nantes, they resolved to petition the king, Francis II., for liberty of worship and for the removal of the two brothers, Francis duke of Guise, and Charles of Lorraine, cardinal and archbishop of Rheims (see GUISE), who were the real rulers of the kingdom and the foremost in the persecution. In the event of a refusal they conspired to seize the person of the king and appoint their own leader, Louis I., prince of Bourbon Condé, as governor-general of the kingdom. The conspiracy failed completely, and a terrible vengeance was exacted: some 1200 of the Huguenots were slaughtered without investigation or trial, their bodies being flung into the Loire until the stream was almost choked by the number. In January, 1562, owing to political changes in France, Cathérine de Médicis being obliged to rely upon the aid of the Protestant party in defence of her son Charles IX., who was under age, an edict was issued which gave the Huguenot noblemen the right to the free exercise of their religion on their own estates. A few months only after this a party of Huguenot worshippers in the little town of Vassy, in the province of Champagne, were attacked by the Duke of Guise and his followers, sixty being slain upon the spot, and 200 more severely, some mortally, wounded. For this butchery he was received with acclamation by the people of Paris, and emboldened by his reception he seized upon the persons of the young king and the queen-mother, and proclaimed the Protestants rebels against the royal authority. The latter rallied round the standard raised by Condé at Orleans, and the civil war was commenced which was to devastate France for nearly thirty years. At the outset the Huguenots were defeated at Rouen, 11th September, 1562, and again at Dreux, 19th December, the same year. In 1563 the treaty of Amboise was concluded, but its stipulations were observed by neither party, and the war was soon recommenced, the Huguenots being again defeated 10th November, 1567, at St. Denis. Reinforced by aid from Germany they were able to threaten Paris, but their leader Condé allowed himself to be again duped by Cathérine de Médicis, and signed the peace of Longjumeau, "leaving his party at the mercy of their enemies, with no other security than the word of an Italian woman." The queen-mother, as soon as the pressure of danger was removed, promptly recommenced the persecution, and within a few months several thousands of the Huguenots were either assassinated or publicly executed. Condé and Coligny fled to La Rochelle, where they were joined by the Queen of Navarre and her son Henry, afterwards HENRY IV. OF FRANCE, at the head of 4000 men. Assistance was also received from Germany and England, and the third war of religion was begun. The Huguenots were defeated 13th March, 1569, at Jarnac, and again at Moncontour, 3rd October, 1569, but they managed to take Nîmes, relieve La Rochelle, and gain the victory of Luçon. Their successes led again to the proposal of terms of peace; and a treaty, in which an amnesty and the free exercise of their religion everywhere except at Paris was granted to the Protestants, was signed at St. Germain-en-Laye, 8th August, 1570.

As with the treaties previously signed, the queen-mother and the leaders of the Roman Catholic party had no intention of observing its conditions, but on the contrary they sought to obtain by treachery that which they had failed to procure by force of arms. In two years their plans were ripe for execution, and the leaders of the Huguenot party having been enticed to Paris, a general massacre of the Protestants was commenced on St. Bartholomew's Day, 24th August, 1572. In the ghastly slaughter that followed, according to the lowest computation, 30,000 of the Protestants of France were destroyed, but many historians place the number killed at a much higher figure. Most of the leaders of the Huguenot party were destroyed in the massacre, but the remainder rallied their scattered forces, and a fresh war was commenced which continued with but few intermissions until the accession of Henry of Navarre in 1589. His reign marks a tranquil period in the history of the French Protestants, and in 1598 they obtained the celebrated EDICT OF NANTES, which though it granted them less than they had anticipated, was yet for a long period the foundation of their liberty. The period succeeding the reign of Henry IV. was marked by numerous outbreaks on the part of the Huguenots, who were distrustful of the plans and purposes of the French court, and ultimately Cardinal Richelieu determined to finally break their

power by the capture of their chief stronghold, La Rochelle. This he effected in 1628, and with its fall and the subsequent surrender of the remaining Protestant towns the religious wars of France came finally to an end. Still the Huguenots were left in the enjoyment of freedom of religion, and being excluded from the court and service of the state, they devoted themselves to manufacture and commerce until they became the industrial leaders of the nation. They followed agriculture in the rural districts, and their farms were among the finest in France. The wine trade of Guienne, the cloths of Caen, the maritime trade on the sea-board of Normandy, the manufactures in the north-western provinces, the silk trade of Lyons, with many other branches of commerce, were almost entirely carried on by the Huguenots, who bore a high reputation for industry and integrity even among their enemies. The consolidation of the power of the king was, however, fraught with danger to the liberties of the Protestants, and as Louis XIV. in his declining years became morbidly superstitious, he sought, under the direction of Madame de Maintenon and his confessor Lachaise, to atone for his own crimes by the suppression of heresy. At first bribery was tried, and a regular fund of secret-service money was set apart for procuring conversions. Then persecution was recommenced, and many thousands were terrified into abjuring their religion by the means of the DRAGONNADES.

Finally, in 1685 Louis revoked the Edict of Nantes, and followed up the revocation with laws of terrific severity against Protestantism. All Protestant worship was forbidden under penalty of arrest and confiscation of property. Ministers were to leave the kingdom within fourteen days unless they became converted. All Protestant schools were closed, and all children born after the passing of the law were to be baptized and brought up as Roman Catholics; all marriages, unless celebrated by the Roman Catholic clergy, were declared null, and the Protestant laity were strictly prohibited from leaving the kingdom.

The provisions of the edict were carried out with relentless rigour, and a desperate flight of the Huguenots ensued. Many thousands had been forced to emigrate by the dragonnades, but now the flight became wholesale, though every effort to check it was made by the authorities. Vauban, who wrote a year after the revocation, estimated the loss of France at 100,000 inhabitants, 60,000,000 francs in specie, 9000 sailors, 12,000 veterans, 600 officers, and her most flourishing branches of manufacture and trade. Sismondi considers the loss to have exceeded 300,000 men, while some modern estimates put the number lost during the whole period of the persecution at not less than 1,000,000. A large number abjured their religion, but a remnant remained who neither fled nor abjured, and whose endurance and determination during the long years of persecution that followed form one of the most remarkable of the records of religious history. The loss of France was the enrichment of other lands, and England, America, Germany, Switzerland, Denmark, Sweden, and Holland all profited by the advent of the emigrants. It is estimated that during the ten years that followed the revocation nearly 80,000 of the Huguenots established themselves in England, and their influence upon the trade and manufactures of the country was both widespread and lasting. The long windows of the silk-weavers' houses still mark the quarter of Spitalfields, London, where not so very long since a considerable French colony, with English assistants, drove a thriving trade, though not a weaver is now to be found there.

The majority of the Huguenots, however, became merged in the general population of England, and their descendants heartily accepted the change of nationality. Many of the latter have since attained to eminence in their adopted country, and are to be found among the leaders of the nation in all branches of its activity. Similar results may be traced in other nations where the refugees took up their abode, and it is said that when the Emperor of Germany rode into Paris at the head of his victorious troops at the close of the war in 1871, not less than eighty members of his personal staff were descendants of the Huguenots who had been driven by persecution from France.

During the early part of the eighteenth century the rigour of the persecution was maintained, but gradually the spirit of the age began to be averse to such methods of maintaining the power of the priesthood, and the interference of Voltaire, after the judicial murder of John Calas, did much towards bringing the persecution to an end. In 1787 an edict of Louis XVI. restored civil rights to the Huguenots, and the Revolution of 1789 and the passing later of the Code Napoleon gave them equal rights with Roman Catholics. At the present time the Protestants of France number about 500,000, and many of their pastors receive a small salary from the state. They nevertheless enjoy a considerable amount of self-government, and they have an excellent reputation as industrious and orderly citizens. In the Protestant churches of France, as in those of other countries, there is a tendency to divide over the questions arising from the progress of scriptural and historical criticism. Some of the leaders are well known for the liberalism of their ideas, and for the work they have done in connection with the advancement of the science of theology, while others, fearing the rationalizing tendencies of modern studies, cling more closely to the Calvinistic standards of their forefathers. (See "History of the Rise of the Huguenots," by Professor H. M. Baird, two vols., 1880.)

HULL or **KINGSTON-UPON-HULL** is a borough and county of itself. It is the chief town in the East Riding of Yorkshire, and a port of first-class magnitude, situated on the north side of the estuary of the Humber, where it is joined by the river Hull, and is 196 miles from London by the Great Northern Railway. This place took its name of Kingston from its purchase by Edward I., who saw the great natural advantages of its position, and determined on the foundation of a fortified town and port. The town, under the name of Mytonwyk, appears to have been of importance in the time of Athelstan. It is first mentioned as a port in 1160. In the Civil War of Charles I. it was the first to close its gates against the king, and it successfully sustained two sieges by the royal troops in 1642 and 1643. The citadel, which was on the east bank of the river Hull, at its junction with the Humber, has been pulled down, and its site converted into streets and shipbuilding yards. There is a battery of nineteen guns at the village of Paull, 6 miles lower down the Humber, where a fort has been erected in a commanding position. A man-of-war is also permanently stationed at Hull.

Hull has many good streets; and extensive warehouses border the river, along which the town and suburbs extend for 2 miles from the Humber. Much has been done to improve the town in late years, especially since the removal of the citadel in 1864. The docks, built upon the site previously occupied by fortifications, communicate with each other, and are very extensive. They are surrounded by broad quays and large warehouses. Additional railway connection with the South Yorkshire coalfield near Barnsley, and junctions with the existing lines of the Lancashire and Yorkshire, the West Riding and Grimsby, the Midland, and the Manchester, Sheffield, and Lincolnshire railway companies, and through them with the Yorkshire lines of the Great Northern and the London and North-western railway companies, have been made in recent years. By means of these works there has been also formed in the town what may be termed an outer-circle railway, the inner circle being formed by the existing Victoria Dock branch of the North-eastern Railway. The Alexandra Dock has a water area of 47 acres; it has a

river frontage of more than a mile; the entrance lock itself is 550 feet long and 85 feet broad. The land upon which the dock is constructed, an area of 150 acres, was reclaimed from the muddy Humber.

Hull has the advantage of being connected by railway with all the manufacturing towns of Yorkshire and the Midland counties, and forms the great outlet for the exportation of their goods. It is also the outlet for the districts drained by the Ouse and the Trent. The number of vessels registered as belonging to the port in 1885 was 840 (200,000 tons). The entries and clearances each average 4500 (2,000,000 tons) per annum. The customs revenue amounts to over £140,000 per annum. The principal imports are timber, corn, cattle, wool, iron, flax, hemp, linseed, tallow, hides, pitch, spirits, sugar, and wine; the exports are coals, woollen and cotton manufactures, yarn, earthenware, hardware, and metals. The value of the exports is nearly £26,000,000 per annum, more than any other port in the United Kingdom, except London and Liverpool. The coasting trade is highly important, there being much traffic in coal. There is also a large transit trade between the north of Europe and America *via* Liverpool. The merchants of Hull were the first in England to embark in the northern whale fishery, but this trade has ceased. The local fishing trade is, however, extensive, and the fish is sent off daily to all parts of the kingdom. The town is an important steam-packet station, and communicates many times weekly with the chief ports in the Baltic, Denmark, Norway, Germany, and Holland, as well as with the other principal ports of Europe and the United States. In the town are large cotton and flax mills, extensive iron shipbuilding yards, manufactories for machinery, chain cables, and canvas, tanneries, soap and chemical works, corn and oil mills. The manufacture of oil-cake is carried on here more extensively than in any other town in the United Kingdom.

Among the chief public buildings are the Royal Institution and Museum, guild-hall, custom-house, dock, pilot, excise, post, and stamp offices, infirmary, Trinity-house, and Trinity almshouses, a handsome town-hall, an exchange, and two merchant seamen's orphan asylums, one opened in 1837 and the other in 1866. There is a branch of the Bank of England, and several other banks. A theatre was built in 1872, in place of one which had been burnt. There is in the market-place an equestrian statue of William III., which is covered with leaf gold. The Wilberforce statue surmounts a fine fluted Greek Doric column, on a square pedestal. In the People's Park (about 27 acres in extent, presented to the town in 1860 by Mr. Z. C. Pearson, then mayor) is a seated marble statue of Queen Victoria, erected in 1863, and one of the Prince Consort, erected in 1868. There is also a statue of the late Dr. Alderson in front of the infirmary, and one of Andrew Marvel, who represented the town in Parliament, was erected in the town-hall in 1868. The benevolent establishments include the Royal Infirmary, founded in 1782, the Trinity-house, instituted in 1369 for the relief of decayed seamen, the Charter-house, for the relief of the poor, and several dispensaries and asylums. The botanic gardens are 56 acres in extent. There is a general cemetery of about 20 acres, and another of about 8 acres specially for Holy Trinity parish. The Holy Trinity Church, the most ancient in Hull, is an exceedingly large edifice. It is 272 feet long from east to west, and is a beautiful and ornate cruciform Gothic structure, with a pinnacled tower 140 feet in height. It has recently been restored internally and externally. St. Mary's Church has also been enlarged. There are several other churches, and a large number of dissenting chapels. The schools include a grammar-school, founded in 1486; Trinity-house Marine Schools, founded in 1785, in which 160 boys are clothed and receive a very superior nautical education free; Cogan School, named after the founder, Alderman Cogan, in which between fifty and sixty poor girls are educated for domestic service, and a marriage portion of £6 each is given to deserving girls brought up in the school.

The following figures show the increase in the population during the last half century. In 1821 the number of inhabitants was 44,965; 54,112 in 1831; 67,095 in 1841; 82,502 in 1851; 97,661 in 1861; 123,408 in 1871; and 162,194 in 1881. Hull returns three members to Parliament under the Act of 1885. For municipal purposes the town is divided into seven wards, represented by fourteen aldermen and forty-one councillors. The mayor has the singular honour of having two maces and two swords, one given by Richard II., the other by Henry VIII.

HUL'LAH, JOHN PYKE, a musical composer of merit, but far better known for his great achievements in teaching masses of choristers and in elevating the standard of musical thought and training in England, was born at Worcester, 27th June, 1812, and received his first musical training from William Horsley, the well-known composer and friend of Mendelssohn. In 1832 he became a pupil of the Royal Academy of Music, and four years later came conspicuously before the public as the composer of Charles Dickens' operetta, "The Village Coquette," performed for the first time at the St. James's Theatre, 5th December, 1836. Two other comic operas, "The Barbers of Bassora" and "The Outpost," were produced at Covent Garden in the two following years, but neither of them met with permanent success.

More important than his compositions, though some of these, such as the songs "The Storm" and "Three Fishers," are very charming, was the educational work to which he devoted himself from an early age. In 1840 he went to Paris to study the system inaugurated by Guilliaume Louis Bocquillon Wilhem, founder of popular musical education and of the important *orphéon* movement in France. The principles of Wilhem's method are contained in his "Guide de la Methode Élémentaire et Analytique de Musique et de Chant," and the same principles Hullah forthwith proceeded to adapt to English uses. In 1841 he started at Exeter Hall classes for the instruction of schoolmasters, and from that modest beginning the vast development of musical training in elementary English schools may be said to have taken its rise. From his elementary classes Hullah formed two schools, an upper and a lower, and commenced giving concerts at Exeter Hall, the members of his upper school forming the chorus and the orchestra being completed by professional instrumentalists. Within twenty years, from 1840 to 1860, not less than 25,000 persons passed through these classes. From this centre Hullah extended his educational activity all over the country. St. Martin's Hall was built for him in 1850, and here he gave concerts of remarkable value, many having for their object the elucidation of the history of music; others introducing works by great composers then almost unknown, such as the immortal Bach, &c. This hall was unfortunately burned down in 1860; Hullah's loss was to some extent made good by a handsome public subscription. But this was not his only work. He became professor of music at some of the most important schools in London, including King's College, Queen's College, Bedford College, and Charter-house, and in 1872 was appointed inspector of training schools for the United Kingdom, a position which he held for ten years. In 1876 the University of Edinburgh conferred on him the degree of LL.D., and in 1877 he had the great compliment of being elected a member of the Society of St. Cecilia in Rome, the oldest musical academy in Italy. Florence also paid him a like honour. He died 21st February, 1884.

Hullah was a prolific author and editor of musical works. His great collections, "Part Music for Four

Voices" and "Vocal Scores," contain a great deal of valuable material, and his educational works, "A Grammar of Harmony," "A Grammar of Vocal Music," and others, are still in use. Of more general interest is "The History of Modern Music," published in 1862, and supplemented three years later by an additional volume entitled "The Third or Transition Period of Musical History." Both volumes are composed of lectures delivered at the Royal Institution, and are remarkable for their pleasant style rather than for deep learning or systematic arrangement. Considering, however, the great dearth of similar works in English, they are not without a certain value. In addition to this, Hullah was a frequent contributor to periodical literature, and for some time acted as musical critic of the *Academy* and other publications. In that capacity he stoutly upheld the forms established by the classical masters; with the more recent developments of modern music he had little sympathy.

HUL'SEAN LECTURES, of Cambridge, correspond with the famous BAMPTON LECTURES of Oxford, but are of more recent foundation. They are part of the benefactions of the Rev. John Hulse (1708–90). This clergyman, who had no family, left his whole estate to the University of Cambridge, in noble emulation of what the Rev. John Bampton had done to the sister university, for the promotion of religious learning. Two divinity scholars were to be maintained at St. John's College, Cambridge, a prize given yearly of £40 for the best essay on some theological topic, a "Christian advocate" appointed, and a lecturer to be elected annually. The Christian advocate became in 1860 the Hulsean professor of divinity. The first Hulsean professor was Mr. Ellicott, afterwards bishop of Gloucester and Bristol. The first Hulsean lectures (which take the form of sermons delivered before the university in sets of from four to six) were delivered in 1820, the lecturer being the Rev. Christopher Benson.

HUMBER. See YORKSHIRE.

HUM'BOLDT, BARON VON (FRIEDRICH HEINRICH ALEXANDER HUMBOLDT), a celebrated naturalist and traveller, descended from an ancient, wealthy, and noble family in Pomerania, was born at Berlin on the 14th September, 1769. His father died when he was not quite ten years old, but under the watchful care of his mother he was educated at home during his earlier years, and was afterwards sent to study at the universities of Berlin, Frankfurt-on-the-Oder, and Göttingen. At Göttingen he became acquainted with George Forster, Heyne's son-in-law, who accompanied Captain Cook in his second voyage round the world, and who inspired his young friend with a desire to study the productions of the tropics. In 1790 he accompanied Forster and Genz in a tour through Germany, Holland, England, and along the two banks of the Rhine; and he published the result of his tour in a work entitled "Observations on the Basalts of the Rhine," &c., which appeared at Berlin in 1790. In 1791 he entered the mining academy at Freiburg, where he enjoyed the benefit of private instruction from Werner, and soon afterwards he received the government appointment of director-general of the mines in the principalities of Anbsach and Bayreuth. With the knowledge acquired in the discharge of these duties he wrote and published in 1793 his "Specimen Floræ Freiburgensis," a work in which he described the cryptogamic and subterranean plants of the district. In 1796 he made a series of experiments to investigate the irritability of the muscular and nervous fibres, the results of which he published in 1797 in a work enriched with notes by the illustrious Blumenbach. On the death of his mother in 1796 Humboldt resolved to undertake a voyage of discovery, and to prepare himself he visited Paris, where he made the acquaintance of Berthollet, Laplace, Cuvier, and others eminent in science, and contracted a friendship with a young botanist, Aimé Bonpland, with whom he set out in 1799 on a journey to Spanish America. It was on the 5th June, 1799, that they set sail from Corunna in the ship *Pizarro*, and after visiting the peak of Teneriffe they reached Cumana, the capital of New Andalusia, on the 16th of July. After verifying their instruments and making other preparations for their journey, Humboldt and Bonpland travelled through New Andalusia and Spanish Guiana, determining the geographical position of the most important stations, studying their natural history, observing atmospheric phenomena, and examining the antiquities of the country and the manners and customs of the inhabitants. This exploration of South America was continued for five years, and whether we estimate it by the romance of personal adventure or the value of scientific research, it is without a parallel in the annals of civilization. After having for seventy-five days navigated in an Indian canoe the Orinoco, the Apure, the Atrabapo, the Rio Negro, and the Cassiquiare, they rested at Angostura in June, 1800, and at the close of the year they went to Havana in Cuba. From thence they went in 1801 to Cartagena, ascended the Amazons in a voyage of fifty-four days, and after visiting various interesting regions arrived on the 6th January, 1802, at Quito, where they spent five months. On the 23rd June, accompanied by Carlos Montufar, they ascended Chimborazo, 19,300 feet above the sea, and the highest point of the Andes ever reached by man. After visiting Lima in Peru they embarked about the end of December, 1802, for Guayaquil, descended to Acapulco, and passing by Fasco and Cuernavaca, they arrived in April at Mexico. In this interesting kingdom they spent more than a year, visiting the mines of Moran, the singular waterfall of Regla, and on the 17th September, 1803, the mud volcano of Jorullo, one of the wonders of the New World. From Mexico our travellers went to Havana, and from thence to the United States, visiting Philadelphia and Washington. Laden with large and valuable collections, they quitted America on the 9th July, 1804, landed at Bordeaux on the 3rd August of the same year, and repaired to Paris to prepare for the publication of their travels. Here Humboldt remained till March, 1805, when he visited Italy and Berlin in succession, and returned to Paris in 1807, where he remained for twenty years, refusing the most liberal offers from the Prussian government. From 1807 to 1817 he published the various parts of his great work, entitled "Voyage aux Régions Equinoxiales du Nouveau Continent pendant les Années 1799–1804." In the production of this wonderful literary performance, which appeared in two forms, folio and quarto, each consisting of twenty-nine volumes, Humboldt was aided by Cuvier and other distinguished naturalists, and the work still remains a principal source of information on the South American continent, and is a masterpiece of classification, inquiry, and learning.

In 1822 Humboldt accompanied the King of Prussia to the congress of Verona, and along with Gay-Lussac he made a scientific tour in Italy, visiting Venice, Rome, and Naples. On his return he spent some time in England, and in 1823 he published his "Essai Géognostique sur le Gisement des Roches." He returned to Berlin in 1826, and in 1827–28 he delivered his celebrated course of lectures on the physical phenomena of the universe, which was afterwards expanded into his "Kosmos." In the spring of 1829, when Humboldt was about to enter his fifty-ninth year, he was invited by the Emperor of Russia to undertake at his expense, and principally for the benefit of science, a journey to the eastern provinces of his kingdom and to Central Asia, having for its main object the advancement of geology and terrestrial magnetism. Having eagerly accepted of this liberal offer, he associated with himself the celebrated naturalist Ehrenberg for the department

of zoology and botany, and Gustavus Rose for chemistry and mineralogy, while he himself was to conduct the astronomical and magnetical observations. With M. Menschenin, a Russian engineer, as their guide and interpreter, the travellers left St. Petersburg on the 20th May, 1829, and embarking at Novgorod on the Volga, they passed by Casan to the Kirghese Steppe, visited Bolgari, the Tartar capital, and went by Persia to Ekatherineberg on the Asiatic side of the great Uralian chain. Advancing along the Southern Ural they arrived at Astrakhan and the Caspian, and returning through the country of the Don Cossacks to Moscow, they reached St. Petersburg in November, 1829, having accomplished in nine months a journey of 2320 geographical miles. The results of this expedition were given in two works—the one by Gustavus Rose and the other by Humboldt. The work of Humboldt, published in Paris in three volumes in 1843, is entitled "Asie Centrale, Recherches sur les Chaines de Montagnes, et la Climatologie comparée." This work, dedicated to the Emperor of Russia, led to the establishment of those magnetical and meteorological observations in various parts of the empire, and in the British colonies in Canada, Australia, South Africa, and St. Helena, by means of which our distinguished countryman General Sabine has been led to such important generalizations. In April, 1835, Humboldt suffered a severe loss in the death of his brother William, who expired in his arms. In 1843 and 1844, when in the seventy-fifth year of his age, he composed his remarkable work entitled "Kosmos," which he dedicated to the King of Prussia, and which was published at Stuttgart and Berlin in three volumes (1847–51). This work was translated into English, under the patronage of its author, by Mrs. General Sabine, and also by Miss Otté, and into French in 1848–57 by MM. Faye and Goluski, under the auspices of M. Arago.

The intellectual services of Humboldt, which our limited space has enabled us but imperfectly to record, were honoured with rewards seldom conceded to the cultivators of literature and science. Among the decorations which he received from different sovereigns, that of grand officer of the legion of honour was doubtless the most welcome. In 1850, on the death of our illustrious countryman Mr. Cavendish, he was elected one of the eight foreign associates of the Academy of Sciences of the Institute of France, and he was an honorary or corresponding member of all the leading scientific institutions in the Old and New World. He died on the 6th of May, 1859, within a few months of his ninetieth year. The loss of such a man, who was beloved by all ranks of society at Potsdam and Berlin, was felt as a public calamity, and every honour was paid to his venerated remains. ("Life of Alexander von Humboldt," by J. Lowenburg, R. A. Lallement, and A. Dove, London, 1874.)

HUM'BOLDT, BARON VON (KARL WILHELM), was born at Potsdam, 22nd June, 1767, and studied law in the universities of Göttingen and Jena. He was thirty-three when he published his first production, which was a critical essay on Goethe's poem of "Hermann and Dorothea." In 1802 Humboldt was appointed resident, and a few years afterwards minister plenipotentiary at the Holy See. In 1812 he was sent as ambassador to Vienna, and afterwards discharged the functions of minister-plenipotentiary of Prussia, together with Hardenberg, at the Congress of Vienna. He continued his diplomatic career at Frankfurt, where he made himself conspicuous through his conciliatory eloquence in the delicate business of dividing Germany among its princes, and afterwards as ambassador at the court of St. James's. In 1819 he was appointed minister and a privy councillor at Berlin. Humboldt and the ministers Von Beyme and Von Boyen tried to persuade the king to be faithful to those liberal principles which he had proclaimed in 1813, and to introduce a general national representation. Unable to stem the king's policy, Humboldt, Beyme, and Boyen tendered their resignation, and Humboldt retired to Tegel, where he henceforth devoted all his time to literature. He died 8th April, 1835. For forty years he enjoyed the well-deserved reputation of being one of the greatest linguists of Europe. He was the author of numerous critical essays, poems, translations from the Greek, and remarks on the Oriental languages, which he published at different periods, his contributions to the science of philology being valuable and important. The greater part of them was collected by his brother Alexander, and published under the title, "Wilhelm von Humboldt's Gesammelte Werke" (Berlin, 1841, four vols. 8vo).

HUME, DAVID, philosopher, historian, and political economist, was born at Edinburgh, 26th April, 1711 (old style). His father, Joseph Hume, a descendant of the noble house of Home of Douglas, died when he was very young, but he was carefully educated through the care of his mother, who was the daughter of President Falconer. In 1723 Hume was sent to the University of Edinburgh, and after remaining there a few years he took the first steps necessary for an entrance into the legal profession. He soon found the study of law totally uncongenial to his feelings, and he appears to have remained for some five or six years at the family home of Ninewells in Berwickshire, devoting himself to the study of the classical writers until his health gave way, and he passed through a period of intense mental and physical depression, which he has feelingly described in a letter to Dr. Cheyne. In 1734 he obtained a situation in a merchant's office at Bristol, but resigned it after a few months' trial, and betook himself to France for the purpose of quiet study and retirement. After a residence of three years, principally spent at La Flêche, he returned to London, and two years later, in 1739, he published his first work, the celebrated "Treatise of Human Nature." This work, which, according to his own account, was planned before he was twenty-one, and was composed before he was twenty-five, contains the first and in some respects the best exposition of his philosophy; but it attracted very little attention at the time of its publication, and Hume, who had anticipated all the fame which arises from vehement opposition, was greatly mortified to find his book not much noticed. His disappointment seems to have had the effect of diverting his studies to such subjects as would attract more attention, and in 1741 he published a volume of essays which had considerable and immediate success. A second edition was published in 1742, and the same year he published a second volume. In 1745 Hume accepted the post of companion to the Marquis of Annandale, a young nobleman of weak intellect, but quitted it after a year's trial, the latter part of which had been attended with a good deal of unpleasantness. In 1746 he became secretary to General St. Clair, whom he accompanied on his journeys to Vienna and Turin.

In 1748, while Hume was absent from England, his "Philosophical Essays" were published, but they failed to attract the attention he had anticipated, and were at the outset almost as quietly received as his "Treatise." In 1749 he returned to England, and in 1751 he published his "Political Discourses," a valuable and original work on the principles of political economy, and also the "Inquiry Concerning the Principles of Morals." In 1752 he was appointed librarian to the Faculty of Advocates in Edinburgh, a position which enabled him to carry out his desire of writing a history of England, the first volume of which, dealing with the reigns of James I. and Charles I., appeared in 1754. The second volume was published in 1756, and then working backward he published the "History of the House of Tudor" in 1759, and two volumes containing the earlier English history in 1761. In the earliest portions of this history he seems to have aimed to

some extent at impartiality, but the latter portions are written obviously in the defence of Toryism. In 1763 Hume accepted the invitation of the Earl of Hertford to accompany him on his embassy to Paris, where his literary fame and his reputation for scepticism secured him much attention. When Lord Hertford was in 1765 appointed lord lieutenant of Ireland, Hume remained at Paris as *chargé d'affaires* till the arrival of the Duke of Richmond. While at Paris he made the acquaintance of Jean Jacques Rousseau, whom he warmly admired and endeavoured to befriend. His efforts were defeated by the morbid half-insane self-conceit of Rousseau, who quarrelled with him and assailed him with malignity.

Hume returned to England in 1766, and the following year was appointed under-secretary of state, an office which he retained until 1769. He then settled at Edinburgh in possession of an ample income, and passed there the remainder of his life occupied in completing his literary and philosophical studies, and enjoying the friendship of many of the most eminent scholars and authors of the period. In 1775 his health began to fail, and after a time his disease, hæmorrhage of the bowels, became so pronounced that he was convinced it could have but one termination. He occupied himself during its progress in writing a biography of himself under the title of "My Own Life," and after displaying great cheerfulness and fortitude, he died 25th August, 1776, in his sixty-sixth year.

In addition to the works mentioned, Hume was the author of "Four Dissertations: the Natural History of Religion, of the Passions, of Tragedy, and of the Standard of Taste," which was published in 1757. Three other works, the "Dialogues Concerning Natural Religion," and the essays on "Suicide" and on the "Immortality of the Soul" were printed posthumously.

As a historian Hume demands respect for the animation and refinement of his style, and from the fact that he was one of the first of modern writers of history to perceive the importance of considering the social and literary aspects of national life as well as its political changes; but his knowledge of his subject was only superficial, and he wrote with a strong party feeling, which renders his work untrustworthy as a record of events. His writings on the subject of political economy are few and scanty, but they contain the general principles of the science, and Hume anticipated by several years the more important of the conclusions established and elaborated by Adam Smith. It is as a philosopher that he will be longest remembered, and in this respect his fame has increased with the years that have elapsed since his death. It was his work to push the relativity of human knowledge to its results, with the consequence of the destruction of many a symmetrical system that had previously been accepted. It was not his function to build up, but he cleared the ground for others, and since his period the metaphysicians of Scotland and Germany have been engaged in the erection of new systems upon different foundations from the old.

Hume's Philosophy.—That a young man not quite twenty-one should conceive so remarkable a plan as that of Hume's "sceptical" Philosophy, a work in itself so far-reaching and in its effects so startling, is almost entitled to the name of one of those very miracles the impossibility of which he himself was so eager to demonstrate. Yet we know from Hume himself that the "Treatise of Human Nature," of which his later works are rather elaborations than amplifications, and which was actually completed when he was twenty-five and published when he was but twenty-eight, was so conceived. That after this great beginning he should have left abruptly philosophy for history and for politics, even though it gave us the famous History and the delightful Essays, is a thing to be regretted. He did truly return to philosophy for a few months, at the age of thirty-seven, when the "Inquiry Concerning the Human Understanding," presented again in more polished form the matter of the treatise, with the important additions of the essays on "Miracles" and on "Liberty and Necessity." Yet the work which Hume deliberately refused to continue had been so splendidly done, so far as it went, that much of it permanently remains as part of the groundwork of philosophy, and the effect upon the thought of his own time was most remarkable. Rousseau fairly idolized him; true, he afterwards detested him, but that was Rousseau's invariable habit with those whom he felt to be equally great with himself; and a greater glory still, the philosopher of Königsberg, the unrivalled Kant, has left it on record that it was Hume who brought him forth from the dreary no-thoroughfares of the old scholasticism.

Locke had taught that the "ideas" (states of consciousness) of the mind are acquired by experience, that it has no innate ideas (a denial now very seriously modified by the evolution-hypothesis and the consequent views of HEREDITY). Hume, probably the clearest-minded philosopher who ever wrote, took up this empirical standpoint as regards the origin of knowledge. The very title of his book shows (as a title should do) the scope of his inquiry. It is "A Treatise of Human Nature, being an Attempt to introduce the Experimental Method of Reasoning into Moral Subjects;" that is to say, Hume had the wit to see that if philosophy was ever to become scientific it must adopt scientific methods; it must experiment, collect facts and data, and from these induce mental laws in the same way as natural philosophers proceed in the discovery of natural laws. Hume, then, was the first to clearly demonstrate what others had shadowed forth—the possibility of a science of mind—indeed of what we now call psychology; and on this science of mind, elucidating what the nature of the mind is and what are its limits, in this anatomy of mind, so to speak, he proposed to found the true philosophy or science of knowledge, whose province is to investigate the origin and limit of those first principles which rule the universe. As soon as it is shown to us in his lucid phrases it cannot be disputed that before we seek for first principles we must ascertain the boundaries of human knowledge, otherwise we may be seeking to know the unknowable.

Now Berkeley had shown conclusively that we can know nothing truly of Matter; we know its *appearances* to us, but of itself we know nothing and can know nothing. Hume did the same office for Mind. In pages which have never been refuted—for they are irrefutable—he has made it clear that mind is knowable only as a succession of states of consciousness, just as matter had been shown to be. Berkeley's position is technically called *idealism*, Hume's is called *scepticism*. But scepticism has an ugly sound, and some philosophical opponents have endeavoured to represent Hume as denying mind. Others had, long before, also represented Berkeley as denying matter:—

"And coxcombs vanquish Berkeley with a grin."

Let us hear Hume himself on this:—"But as experience will sufficiently convince anyone that although he finds no error in my arguments, yet he still continues to believe and think and reason as usual, he may safely conclude that his reasoning and belief is some sensation, a peculiar manner of conception, which 'tis impossible for mere ideas and reflections to destroy" ("Human Nature," part iv.) That is to say, Hume's brilliant logic is, on his own showing, directed to break down the false delusion that we can ever attain to the knowledge of *what mind is*, and not to support the absurd contention that there is no such thing as mind. Hume goes on: "Thus the sceptic still continues to reason and believe, even though he cannot defend his reason by reason; and by the same rule he must assent to the principle concerning the existence of body (matter), though he cannot pretend by any arguments of philosophy

to maintain its veracity." (Locke had already counselled men not to try to penetrate beyond phenomena, for the task was beyond man's power, and they should, said he, be content therefore "to sit down in quiet ignorance.") Hume puts the metaphysicians in this dilemma, and though he has been furiously assailed and denounced from his day to our own, the metaphysicians have never got out of it. Either, says he in effect, you must (1) hold that what you see is the object itself, an opinion which can instantly be shown to be absurd; or (2) you must hold that you see representations of objects only, and in the latter case human reason is so constituted that you can never find a link whereby definitely to connect the representations with the objects they represent.

(But is it true that in a century and a half we have advanced no step towards the comprehension of mind? The biological school, whom their adversaries nickname Materialists, not very aptly, assert the contrary. They consider they have advanced by determining to regard mind as a *function*, and not as an *entity*. This was the brilliant suggestion of CABANIS, so often unjustly ridiculed as asserting that the "brain secretes thought." The true statement of the biological view of mind is that sensibility is to the brain what contractility is to the muscles; neither can exist without its proper tissue. The mind is on this view much more than a series of states of consciousness—it is a vital process or function, and so long as the tissue which possesses it continues to exist, it has a perfect continuity. This view affords the permanent link to the individual "impressions and ideas," or what we call successive states of consciousness of the mind, which Hume sought, and sought in vain. Further, it lends support to another position of Hume's, which roused a storm of denunciation round his head, namely, that animals, or at least the higher vertebrates, are endowed with thought and reason as well as ourselves, though it may be in a less degree.)

Unfortunately, as has already been regretted above, Hume was satisfied with showing the futility of pure metaphysics, of inquiries into the nature of existence and the like, and only in a few cases did he fully develop the powerful advance he thus opened. The most famous of these developments are his attacks on causation and on miracles. A few remarks on each will serve to make his position intelligible.

Everything is said to have a cause, except God, who is the First Cause. But Hume examines this dogma, and finds that the assumed especial power (*nexus*) of causation can in no case be traced out. We know that our hand is burned every time we put it in a flame, as the burning is always followed by pain; but why the flame should produce pain we know not, nor do we know that it will always do so, nor can we assert, even if those flames we know do burn, that all flames will likewise burn. Hume tries to show that it is only long-continued habit that gives the prestige of "cause" to a certain well-observed succession of phenomena. His merit is, as elsewhere, in so effectually demolishing the fallacy by his irresistible logic that the victory is won, rather than in his being the first to attack the fortress; for Hobbes had long before said, "What we call experience is nothing else but remembrance of what antecedents have been followed by what consequents." This is to say we merely assume that the future will resemble the past. But Hume in demolishing the visionary force of causation went too far when he attributed it to habit; since one glaring instance, as for example the attack of a fierce animal, or the burning of fire, is quite enough to stamp the causal belief upon us. We should undoubtedly keep away, under the firm persuasion that approaching the one too closely would bring about a bite and approaching the other a scorching, even after but the one solitary instance supposed. It is not necessary to bring the future in at all; we do not say to ourselves, "Fire always has burnt, it therefore always will burn," we simply recognize burning as a part of the properties of fire. The word fire connotes certain sensations—burning is one of them, that is all; it needs no second instance, if the first is sufficiently vivid to impress itself upon us. Nevertheless Hume made a great step towards this more modern view, and it was especially his demonstrations on causation which stimulated Kant to begin his own studies.

Hume's view of miracles was very startling to his own time, but to ours does not possess much more than a historical interest. He asserted miracles to be impossible, because he defines them as "violations of the laws of nature." But this definition cannot pass, because it is simply impossible to violate a law of nature. In Hume's day it was not yet perceived that this phrase is merely a convenient way of expressing a generalization which we have made, a theory or working hypothesis which we have hit upon, to collect and link together a number of observed phenomena for convenience' sake. To look upon such a hypothesis as an ultimate fact is to assume the power of understanding the infinite with our finite minds; is to pass by the warning of the Hebrew seer—"Canst thou by searching find out God?" Any of our so-called "laws" of nature may be changed to-morrow by a new discovery. Let us take an example. It was a law of nature that the heavenly bodies moved in circles (or cycloidal curves), whence most philosophers considered absolute unimpeded motion to be circular in its tendency; but it appeared also a law of nature that all things near our planet fell to the earth, and later on another law of nature—that uninterrupted motion on the earth's surface was in straight lines—was discovered. The first law at once now disappeared, and the circular orbit of the moon was explained by her perpetual fall towards the earth from that motion in a straight line which she would otherwise enjoy; so also with the planets in regard to the sun, &c. The circular-motion law was seen to be no law at all. To talk therefore of flying lead, for example, as violating a law of nature is absurd; if a scientific man saw lead fly he would simply set to work to find the reason why, and that being found, the present law would yield to some larger hypothesis concerning lead, embracing the new fact of its rising superior to gravity under certain conditions.

Thus Hume's argument as to miracles in general falls by its own definition. But let us define a miracle as a something transcending all ordinary experience, and Hume's reasoning at once tells. We agree with him that the more uncommon a fact is the more weighty must be the testimony for its occurrence—common evidence will not do. A large number of miracles are philosophically incredible, that is to say, as historic facts they have not sufficient testimony. This is why Christians reject Mohammedan miracles, and Mohammedans Christian; this is why Protestants reject the miracles of Roman Catholics, and Roman Catholics those of paganism. Each faith views the assertions of the other faith from the mere historic or philosophic standpoint. But the professors of each religion do not themselves apply this criterion; they allege they have proof, so far as their own miracles are concerned, which is to them more satisfactory than any ordinary testimony according to the laws of evidence; their witnesses are such as compel belief, even of their unsupported testimony. If only each religious community would bear in mind this consideration mutual tolerance would become enlarged, and Hume, so often decried as irreligious, will then have conferred upon us one of the most deeply religious benefits we have ever received.

Finally, it is perhaps necessary to say one word on Hume's religious standpoint. It is the grossest untruth to call him, as many have done, an atheist. He is bitter against priestcraft, it is true—almost as bitter as against England and Englishmen, whom he cordially detested. But he defines clearly what it is that he opposes. "By priests

I understand only the pretenders to power and dominion, and to a superior sanctity of character distinct from virtue and good morals. These are very different from *clergymen* . . . there is no rank of men more to be respected than the latter" (essay on "Superstition"). Elsewhere Hume expressly says ("Natural History of Religion") that he holds the existence of God, and that he believes the divine attributes to have some analogy to human intelligence. His position is indeed that of an agnostic. He believes in God, but he is content to admit that he knows, and at present can know, no more. He even desires (in the same work) "that heaven would be pleased to dissipate this profound ignorance by discovery of the nature, attributes, and operations of the Divine Object of our faith;" and elsewhere asserts, "with reasonable men the question can never be concerning the *being*, but only the *nature* of God," and he piously ascribes to him every species of perfection. It is quite time therefore to free this great thinker from the reproach of atheism, that is, of blindness, either absurd or pitiable as we prefer, to the highest sensations of the soul.

The editions of Hume's "History" are numerous. His collected writings were published in 1826 and reprinted in 1854; but the best edition is that of Messrs. T. H. Green and T. H. Grosse, published in four vols. in 1874. See also "Hume," by Professor Huxley, in English Men of Letters (London, 1879), and the "Life and Correspondence of David Hume," by J. H. Burton, two volumes (Edinburgh, 1846).

HUME, JOSEPH, the champion of economy in national finance, and for thirty-seven years foremost in the ranks of parliamentary liberalism, was born at Montrose in the year 1777. His father, a shipmaster, owner of two vessels, died when he was five years old. His mother, a woman of strong mind and great good sense, secured for him the best education she could obtain, and having made choice of the medical profession he was apprenticed at fourteen to a surgeon at Montrose. He migrated three years later to the University of Edinburgh, completed his medical studies, and in 1795 was admitted a member of the Edinburgh College of Surgeons. He made a voyage to India in 1796, and in 1797, after attending the hospitals, was admitted a member of the College of Surgeons in London. He now entered as an assistant-surgeon the service of the East India Company, and observing that few of the company's servants knew the languages in use in Hindustan he applied himself to master them. With this knowledge, and with his inborn aptitude for accounts and business, he soon added to his medical duties those of Persian interpreter, of postmaster, and of paymaster of the division to which he was attached on the breaking out of the war with the Marhattas in 1803. He worked so hard and so successfully that when he returned to England in 1808, it was as the possessor of a fortune of £30,000 or £40,000. In 1809 he made a tour of minute observation through the United Kingdom, visiting every place of manufacturing importance. He passed the greater part of the years 1810–11 in foreign travel, visiting Spain, Portugal, Sicily, Egypt, Turkey, Greece, &c., keeping his eyes ever open to any practical arrangement which might be carefully imported into this country. It was at that early period that, struck by what he had seen at Palermo (as he once told the writer of this memoir), he pressed on the authorities at home the system of extramural interments, which was afterwards carried into effect. To these continental researches he added a careful study of the constitution and political history of his own country. On his return to England in 1812 he entered the House of Commons as member for Weymouth, a vacancy occurring through the death of Sir John Johnstone. Hume was passing through the lobby of the House when Bellingham shot Mr. Percival, and it was he who seized the assassin, and held him fast until he was arrested. He had arrived from India with a strong belief in the excellence of the government as it was, and he took his seat on the ministerial side of the House. His views, however, were soon modified, and his advocacy of a liberal commercial policy so dissatisfied the trustees of Sir John Johnstone that they refused to return him to the new Parliament of 1812. His first recorded speech in the House was one in favour of popular education. For some years afterwards he devoted himself to political and social action out of Parliament, cultivating the acquaintance of advanced reformers and promoting the establishment of savings banks and of Lancasterian schools. During this period of absence from the House of Commons Hume began his exertions in the court of East India proprietors, where, in 1813, he fought single-handed the battle of free trade. In 1818 he was returned to Parliament for the Montrose burghs, which included his native town, and he continued to represent them until 1830. From 1830 to 1837 he represented the county of Middlesex, which he exchanged in 1837 for Kilkenny. In 1842 he was re-elected for the Montrose burghs, and continued to represent them till his death, which took place at his seat, Burnley Hall, Norfolk, on 20th February, 1855.

With his varied knowledge, ever open to increase, his indefatigable industry, and his imperturbable temper, he soon took rank in the House of Commons as a Liberal leader of no ordinary calibre. Other men might have larger intellects or greater oratorical gifts, but the usefulness of Joseph Hume was never vitiated by a suspicion that he wished either to play the part of a demagogue or to grasp the spoils of office. To name the political and social causes of which Hume was the unwearied advocate in the House of Commons and out of it, would be to recapitulate the programme of the Liberal party from the commencement to the close of his parliamentary career. Financial reform was from first to last his peculiar question. His extensive knowledge of the details of government departments was something startling, and his demands for retrenchment and economy were not of the vague kind which it is so easy to cultivate, but based on and supported by facts and figures familiar to him as the alphabet. When a job or a piece of extravagance was proposed, "What will Joseph Hume say?" was an expression which became proverbial. In the pre-reform era one of his most notable achievements was the repeal which he procured of the combination laws; and when the Reform Bill came, he saw ministers of the crown endeavouring to gain popularity by carrying out the reforms which he had long promoted almost single-handed. It was his exertions—long, laborious, and costly—that gave the deathblow to Orangeism in the army in the years 1835–36. It was he who moved for the appointment of the import duties committee of 1840, which led to the tariff reforms of Sir Robert Peel. It was to Hume that the public owes the throwing open of such places as Hampton Court and Kew Gardens. He was the spokesman of every grievance, public and private; and to the last his house in Bryanston Square was the resort of all who had injuries to be redressed or suggestions for improvement and reform requiring an advocate. During the latter years of his life he enjoyed, without the embarrassments of office, the position of a veteran minister; and being nearly the oldest member of the House, where he had never made an enemy, he was respected and esteemed by the leaders of all parties in Parliament. It should be added that though his name was identified with financial economy and retrenchment, Hume was always not only ready, but eager to support every claim on the public purse which had in view the social or educational elevation of the people, or indeed any object of genuine public utility; for instance, he may be said to have created the present system of lighthouses.

HUM'FREY, PELHAM. See Humphrey.

HUMID'ITY is that condition of a substance through which it communicates to a body in contact with it some of a liquid which it may have absorbed; and the term is commonly applied to the atmosphere as regards the amount of moisture it contains.

The humidity of the atmosphere is originally caused by the evaporation of water from the seas, lakes, &c., of the earth; and the quantity of moisture which a volume of air is capable of containing depends upon the temperature. The consideration of this absorptive power is often termed *atmometry*. If the temperature be increased, the air gains the power of receiving more vapour; and the atmosphere becoming saturated with moisture, if the temperature be suddenly lowered, a precipitation of water takes place. Thus is formed DEW; and if the chill is so great as to lower the air below the freezing-point, ice, not water, is deposited, and we have HOAR FROST. The phenomena of aerial precipitation and condensation of water in all its forms are grouped for study under the generic name of *hyetometry*.

The humidity of the atmosphere generally decreases from the surface of the earth upwards; and when the density of the lower strata is great, the clouds ascend into the drier regions, where they are readily absorbed. This circumstance accounts for the fact that, when the mercury rises in the barometer, the weather frequently becomes fair. The amount of moisture in the atmosphere is measured by the various kinds of *hygrometer*, and the consideration of all the phenomena of aerial humidity has obtained the name of HYGROMETRY.

The effect of humidity on the dimension of bodies is always to increase them; but when a watery vapour penetrates between the twisted fibres of cordage the cordage swells out transversely, and thus, as regards its length, becomes shortened, but as regards its total bulk is increased. Most salts absorb water, and thereby increase in weight.

HUMIRIA'CEÆ, an order of plants belonging to the cohort Geraniales among the POLYPETALÆ. The species, about twenty in number and classed in three genera, are all natives of Brazil or Guiana, with the exception of one species, which is found in Africa. They are trees, generally with balsamic juice; the leaves are alternate, undivided, leathery, without stipules. The flowers are regular, and of a white colour; there are five small sepals, five petals; stamens numerous, rising from below the ovary, with united filaments, the connective of the anthers fleshy and produced into a conical projection beyond the anther-cells; disc annular or toothed, surrounding the ovary; the ovary superior, not lobed, with five and sometimes six or even seven cells, and simple style; ovules pendulous, with one or two in each cell; fruit drupaceous; and seeds with fleshy albumen.

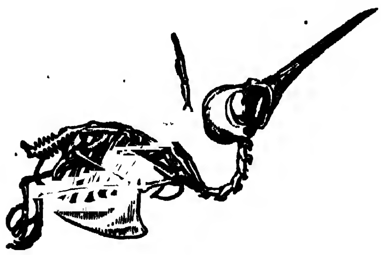
Humirium balsamiferum, a tree 40 feet in height, is a native of Guiana. Its bark is thick and abounds with a red balsamic fluid, which resembles storax in smell; after it has exuded from the tree it becomes hard and transparent, and when burned affords an agreeable odour. An ointment prepared from it is used for pains in the joints, and internally as a remedy for blennorrhœal discharges and attacks of tapeworm. The negroes and natives of Guiana use the bark in slips for the purpose of flambeaux; they also use the red-coloured wood in building their houses. *Humirium floribundum* is a native of Brazil. Its trunk, when wounded, yields a fragrant liquid yellow balsam, called Balsam of Umiri, resembling in its properties copaiva and balsam of Peru.

HUM'MEL, JOHN NEPOMUK, a distinguished pianist and musical composer, was born at Pressburg, 1778, and died at Weimar, 1837. His father was a musician, and led the band for Schikaneder, that theatre manager and friend of Mozart for whom the great musician wrote the "Zauberflöte" to extricate him from pressing difficulties. Mozart's friendship was turned to good account by the elder Hummel, and John became for a considerable time a resident in Mozart's house. Afterwards he studied with Albrechtsberger and the immortal Haydn. Under such auspices his talent developed to its utmost. His playing was beautifully smooth and correct, but wanting in poetry and enthusiasm. The same may be said of his compositions, which still have power to charm, and remain established favourites, but have no force to stir their hearers into the ecstasy which is at the command of Beethoven and Schubert. Yet in his prime Hummel was considered as the equal of Beethoven by probably more connoisseurs than those who held the contrary opinion. Beethoven at one time liked Hummel, but took a dislike to him, perhaps unjustly, through suspecting him of false play with the Esterhazys, who did not like his mass in C. But when Beethoven lay dying the kind-hearted Hummel was one of the first to hasten to his bedside. He had succeeded Haydn as the musical director to the magnificent Esterhazy family, and later on he held similar posts at the courts of Stuttgart, of Weimar, and of the Russian grand-duchess, Maria Paulowna. Not only in his own country and in Russia, but in France, Holland, and England, his reception, whenever he visited those countries, was almost unequalled, and from our point of view incredible, compared with the popularity of far greater men. If in his own day Hummel was over-exalted, in our time he is punished by an equally absurd depreciation of his undoubted merit. His pianoforte works, his septet, and his graceful trios for pianoforte and strings, can never fail to please those who do not demand to be always "in the seventh heaven."

HUMMING-BIRD is the name given to the beautiful little birds forming the family Trochilidæ, from the sound made by the rapid vibration of their wings. The birds forming this family, which are undoubtedly the gems of our ornithological treasuries, are peculiar to America and its islands, in the tropical parts of which they abound, adorning the gardens, fields, and woods, and even the mountain sides to a considerable height, with their swiftly glancing fairy-like forms and brilliant sparkling colours. These charming little birds, the smallest, as a group, of all the feathered tribes, are furnished with a long and more or less acute bill, which is sometimes straight and sometimes curved, and has the lateral margins of its upper mandible dilated beyond the edges of the lower one. The nostrils are situated at the base of the upper mandible, and concealed beneath a large scale, which is sometimes covered with feathers. The wings are long and pointed, reminding one somewhat of those of the swifts, with which the humming-birds have a very manifest affinity; the quill feathers are graduated. The tarsi are delicate, slender, naked, or feathered to the heels, scutellated, having in front three equal toes, the two internal ones a little connected at their base, the hind toe rather stout, all furnished with compressed, curved, and hooked claws, which are rather robust.

If we look at the skeleton of a humming-bird (remembering that great and small are relative terms) we shall be struck with the provision made in the sternum (breastbone) and parts connected with it, for the vast development of the muscles of flight. The sternum is deep and wide, and the pectoral muscles form nearly the whole, by weight or measurement, of the fleshy substance of the bird. The tongue is the principal organ on which these brilliant little creatures depend for the means of obtaining their food—nectar and the insects which lurk in the nectaries of flowers. It is supported by the branches of the hyoid bone, which are prolonged round the back of the skull and act like springs for its protrusion. This organ is very long, and can be protruded a good way from the

bill. It is composed of two musculo-fibrous cylinders attached to each other throughout a great portion of their continuity, and separated towards the point; so that the two tubes, slightly enlarged towards this part, separate from each other, and each presents a little blade which is concave within and convex externally. The two small blades, or elongated spoon-like terminations, seize the insects, which, on the tongue being retracted, are caught by the mandibles and forthwith swallowed. The long and slender bill comes in admirably to aid the insertion of the



Skeleton of Humming-bird.

tongue into the nectaries of flowers. The food of these birds consists mainly of small insects and only secondarily of the honeyed juice of flowers. Indeed, according to Wallace several species, especially of the genus Phaëtornis (HERMIT), never visit flowers, but live on the insects they find on leaves, stems, &c.

The mode of flight of the humming-birds is peculiar. They remain as it were suspended in the air, in a space barely sufficient for them to move their wings, while the humming noise proceeds from the surprising velocity with which they perform the motion that keeps their bodies in the air apparently immovable for hours together. When they are thus poised or suspended, their wings become invisible or only like a mist. No one has described their flight more accurately than Buffon:—"The vibration of the wings is so rapid that the bird poised in the air appears not only immovable, but entirely without action. It is seen to stop thus for some instants before a flower and dart off like a gleam to another; it visits them all, plunging its little tongue into their bosom, caressing them with its wings, without ever settling, but at the same time never quitting them." Some species have been observed capturing flies on the wing in the same way as the flycatchers, namely, by taking up a post of observation upon the tip of a dead branch or twig, and flying off in pursuit of their prey as soon as it comes in sight.

The plumage of the male is surpassingly brilliant, with gorgeous metallic reflections, exhausting the vocabulary of the lapidary in its description. The livery of the females is nearly always sombre, tarnished, or with but little brilliancy. The young resemble the females, and only gradually gain the dress of the males. The feathers have their barbules constantly disposed in facets, even in those whose plumage is dull. In a few species the plumage of both sexes is, comparatively speaking, sombre.

The small size of these birds has already been referred to. The largest is only $8\frac{1}{2}$ inches in length, while the smallest is no more than $2\frac{3}{8}$ inches. Their voice is in general nothing more than a sharp monotone, frequently repeated under the influence of excitement. At other times they are silent for hours. Their nests are as wonderful as any that are made by feathered nest-builders. They vary greatly in form and structure, but in all the soft and delicate materials are so put together as to furnish as much warmth as possible—an object of importance where the body of the parent is generally so small. Cotton, thistle-down, delicate fibres, a fungus-like substance and other soft materials woven into a compact and fleecy texture, enter into their composition. The outside is in most instances covered with lichens for the sake of concealment. The nest generally appears to be made by warping spiders' webs over fragments of plants, their down, lichens, &c.; and the lichens, which are never turned the wrong way, are secured by the webs only. The humming-birds generally lay two white eggs of an elongated form, which in some species are extraordinarily small. The parent birds are bold, and even fierce, in the defence of their young. In sleeping they frequently suspend themselves by the feet with their head downwards, in the manner of some parrots.

The ordinary French term for these birds is *Colibri*, according to Buffon a Carib word. The generic title of Linnæus is infelicitous, *Trochilus*, being the name given by Aristotle to two distinct birds, as it would appear—one probably a wren, the other one of the Charadriidæ or plovers, of Egypt.

Though the tropics of South America form their head-quarters, it is not only in the hot and low valleys that the humming-birds abound; they frequent also the cold and elevated regions. The Ruby-throated Humming-bird (*Trochilus colubris*) winters to the southward of the United States, and ranges in summer to the fifty-seventh parallel, and perhaps even still further north. Two species of Hillstars, *Oreotrochilus chimborazo* and *Oreotrochilus pichincha*, live on lofty mountains at an elevation of 16,000 feet, just beneath the line of perpetual snow. Over 400 species of humming-birds have been described, distributed, according to the views of some ornithologists, among a very large number of genera.

The Ruby-throated Humming-bird (*Trochilus colubris*), one of the most widely distributed species of this family, is a beautiful bird, of a rich golden-green colour above, and white, with a golden-green tinge beneath, except on the throat, which is of the most brilliant ruby-red; the wings and tail are purplish-brown, and the bill, eyes, and feet black. The female differs from the male in the absence of the brilliant crimson colour on the throat, and in having the tail feathers tipped with white. The total length of this bird is $3\frac{1}{2}$ inches.

The Ruby and Topaz Humming-bird (*Chrysolampis mosquitus*), one of the commonest species of the group of humming-birds, specimens of which are imported into Europe by thousands, is found abundantly in Brazil and Guiana. Common as it is, however, the male is an exceedingly beautiful bird, the whole top of his head being of a brilliant ruby-red, and the chin, throat, and breast golden or topaz yellow; the rest of the plumage exhibits different shades of brown, and the tail is of a rich dark chestnut-red.

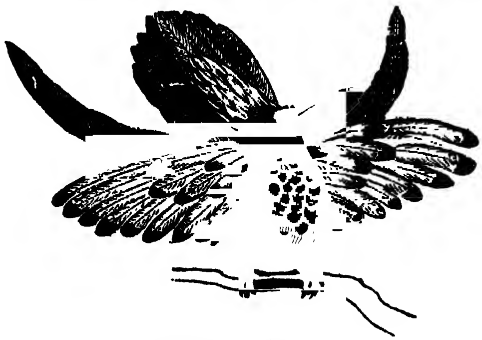
The Giant Humming-bird (*Patagona gigas*), the largest species of this family, measures between 8 and 9 inches in length; but as the tail is comparatively short, its bulk is far greater than that of some other species which approach it in total length, but in which the tail feathers are much elongated. It is of a pale brown colour, with a greenish gloss above and reddish beneath; the wings, which are very long, reaching nearly to the extremity of the tail, are blackish-brown. This species inhabits the west coast of South America.

Gould's Humming-bird (*Lophornis gouldii*), has the breast a lustrous emerald-green. A fan of white feathers, ocellated each at the tip with sparkling gold and emerald, encircled by deep green, adorns each side of the neck, rendering the bird a very beautiful object.

The Puff-legs (Eriocnemus) have the legs surrounded by a tuft of delicate small plumes, which are usually of a snowy white colour. The Racket-tails (Steganura) are distinguished by having the outer tail-feathers in the male much elongated, very slender for part of their length, and terminated by a broad racket or spatule. The Sword-

bearer (*Docimastes ensiferus*) has its bill exceeding in length the entire body.

A very elaborate and exceedingly handsome work on "Humming-birds," in five folio vols., with richly coloured plates, by Mr. John Gould, F.R.S., was published in 1862.



Gould's Humming-bird.

Mr. Gould's collection of humming-birds was purchased in 1881 by the trustees of the British Museum for the national collection.

HUMMING-BIRD MOTH (*Macroglossa stellatarum*), one of the HAWK-MOTHS (Sphingidæ), so closely resembles a humming-bird when flying as to be constantly mistaken for one, even by people accustomed to the sight of humming-birds in their native haunts. Mr. Bates ("Naturalist on the Amazons") says of a species of the same genus that it so closely resembles a humming-bird, both in appearance and habits, that the natives, and even educated whites, believe in the transmutability of them. Mr. Bates himself often shot one of these moths by mistake for a humming-bird. The common humming-bird moth is tolerably abundant in this country, and may often be seen apparently suspended in the air with its long proboscis thrust into a flower sucking up its honey. The thorax and fore wings are brownish-black and the hind wings yellow, deepening into orange and ruddy brown at the margin. The abdomen has a tuft of brownish-black hairs at its extremity. The span of the wings is about 2 inches.

HUMOPIC ACID, an acid obtained indirectly from opium, by heating narcotine; ammonia is given off and this acid, having the formula $C_{22}H_{20}O_7$, is produced. It is insoluble in water, but soluble in alcohol, forming a yellow solution. The salts are yellow or brown.

HUMOUR is that combination of the ludicrous with tenderness and kindliness which is as far superior in the duration of its power to please as in immediate effect it is inferior to the sparkling exuberance of wit. The humour of Addison's *Spectator* is as fresh to-day as under Queen Anne, while the wit of Congreve, and even of Swift, has grown stale. Goldsmith's "Vicar of Wakefield" and Sterne's "Uncle Toby" are for all time; while hardly any man now cares much for the brilliancy of the wits of their time, if even he knows their names. Were Falstaff only witty, we should laugh at his jests and despise him; but his infinite humour causes us not only to laugh at him and with him, but to have a considerable sneaking kindness for him, in spite of his absolute lack of everything that is virtuous, honourable, or decent.

HUM'PHREY, DUKE OF GLOUCESTER, called *par excellence* the "good Duke Humphrey," was protector of England in the minority of Henry VI., his nephew. He was born in 1391, and died in 1447 in very suspicious circumstances, presumably smothered in his bed, as Shakspeare indicates ("Henry VI." Part I.) He had warmly opposed, in 1445, that marriage of the young king with Margaret of Anjou which was destined to bring so many disasters upon the kingdom, and had ever after been a strong partisan of continuing the French war (the HUNDRED YEARS' WAR). He was summoned to a Parliament at Edmondsbury early in 1447, and was put under arrest. While still under surveillance he died. He had a noble love of letters, and collected a fine library. He was very generous and much beloved, but he was, on the other hand, exceedingly dissipated, and the reason for the honourable epithet he has received is hard to seek. In 1441 his second wife (Eleanor Cobham) was condemned for witchcraft practised with a view to compassing the young king's harm, and had to do penance with a taper in London streets, barefoot and clad only in a penitential sheet, an incident turned to good account by Shakspeare. There is an ancient proverb bidding a hungry man "go dine with Duke Humphrey." It is to this duke that it refers. He had so accustomed the poorer sort to his free quarters that "dining with Duke Humphrey" was no jest. But at his death, and while his herse [see HERSE] still was standing in St. Paul's, the joke against the dinnerless was to bid them go find the duke and once more taste of his bounty. He was buried, not at St. Paul's, however, but at St. Alban's Abbey; yet the aisle which had held the herse of ceremony was long called Humphrey's Walk, and a fine monument of Sir John Beauchamp there was set down as the duke's by the vulgar, as we know from Stowe the antiquary. It is certainly astonishing that Gloucester, merely for his lavish good nature, should have stuck so in the people's memory, since he was far inferior to his brother Bedford, and in no way comparable to his brother Henry (Henry V.)

HUM'PHREY, PEL'HAM, as he is usually called, though he himself wrote his name *Humfrey*, a famous musician of Charles II.'s time, was one of those wondrous youths who occasionally scatter to the winds all our opinions as to the value of study and experience in art. Mendelssohn dying at thirty-eight, Purcell at thirty-seven, and Mozart at thirty-two, make us lament their untimely end; but Humphrey's brief span was over at twenty-seven. Yet how lovely his music is, how original, and how masterly, those who have taken the trouble to consult our older anthems well know. A little of his work is still in constant cathedral use, and more deserves to be. Seven of his anthems occur in Boyce's fine well-known collection.

He was born in 1647, the nephew of a noted Cromwellian military officer, but his family submitted at the Restoration, and in 1660 the boy of thirteen was received into the king's chapel. But as Charles, after his long stay in France, wearied of the solemn church harmonies of the Elizabethan school which formed the music of his chapel, he sent Humphrey over to the great Lully in Paris from 1664 to 1667. On his return he delighted Charles by producing music in the highest modern style, and with an English flavour of its own inimitable by the purely French artists. He was made "Master of the children of the Chapel Royal" in 1672; but he died, all too soon, in 1674. Not too soon, however, to impress his best characteristics upon his scholar Henry Purcell, the greatest musical glory of our land. Humphrey was buried in the cloisters of Westminster Abbey.

HU'MUS (Lat., vegetable mould), a name given by chemists and scientific agriculturists to that dark and crumbly soil which has been formed by the remains of plants exposed to the different stages of decomposition or rottenness. Thus when roots, wood, straw, or dung lie upon or in the earth they absorb moisture; first becoming brown and soft, they afterwards assume a blackish-brown colour, and finally become black and pulverulent, as may be easily seen on examining the superstratum of the soil in forest lands. In truth, vegetable fibre may be regarded as the principal producer of humus; such as leaves, straw, moss, peat, &c. When these substances turn to putrefaction and decay, their colour becomes dark,

and they are converted into carbonic acid and water, which can be absorbed as nutriment by plants; for the fallen leaves and decayed roots, as well as the insects and worms which feed upon them, become subject to decomposition and decay when the vital principle is gone. Then the carbon they contain is converted into carbonic acid, and the humus, when air and moisture can act upon it, is by degrees still further decomposed, and thus continually furnishes fresh supplies of carbonic acid to the roots of plants. Of all the ingredients of soils humus possesses the strongest power of absorbing the moisture, oxygen, and other constituents of the atmosphere favourable to vegetation.

HUNDRED, in commerce, is a numerical amount which varies in different countries. In England the hundred of weight is usually estimated at 112 lbs.; the hundred of number is often 120. In Riga and Elsinore the great hundred is twenty gross or 2880 pieces. In Belgium the hundred of articles in general sales is 164 pieces. The hundred deals or planks are reckoned at 120.

HUNDRED, a division of land in our country dating from the English conquest of Britain. The hundreds are fast decreasing in number. The term answers to the *pagus* of Tacitus. Professor Stubbs gives so clear and concise a definition of a hundred in his "Constitutional History" that it is best to quote it. It is, he says, "the union of a number of townships for the purpose of judicial administration, peace, and defence." The first of these purposes was served by the HUNDRED MOTE for many centuries after that assembly had ceased to concern itself with either of the other two.

The hundred is especially a South English term; the *wapentake* is a far more usual name for the subdivisions of the shires in the north. This evidently means "weapontake," that is to say, the military unit of defence, the local regiment made of dwellers on the soil. But of *hundred* there are several conflicting etymologies proposed. The first, and perhaps the best, is that which makes it the military unit, corresponding to the wapentake; that is, the association of so many families or townships as would furnish forth a hundred warriors. Or it may have been a hundred hides of cultivated land, with the fringe of moorland or woodland which surrounded each mark, and was of varying size, the differing size of the surviving hundreds being thus accounted for. Or it may have been the settlement of a hundred of the original English (*Englisc*) families as they arrived from their continental home of origin. Or, finally, it may have been an association of a hundred householders for peace and justice. This goes best with the hundred mote, with the varying size of the hundred, and with other parts of the problem not here enlarged upon. Certainly when in a charter of Edgar (Stubbs, "Select Charters," 70) we first meet with the term it is such a union as this. We hear of it under Alfred, but it is not described. From applying to the hundred men (or families) it readily came to be used for the territorial division supporting these men. The union of the hundred was headed in Old English times by the *hundreds-ealdorman*, as the shire (which was formed by the union of many hundreds) had its greater *ealdorman*. In Kent the hundreds were grouped into *lathes* or *lethings* (a word meaning levies), and the organization of the lathe was used to the supersession of that of the individual hundreds. In Sussex the six *rapes* (Icelandic *hreppr*, a district) of Lewes, Pevensey, Hastings, Chichester, Arundel, and Bramber, which divide the entire county, answer to the Kentish lathes; and in Yorkshire the shire is grouped into three still larger *trithings* (third parts), now called *ridings;* but in these cases the hundreds were not so thoroughly merged in the larger groupings as in Kent.

HUNDRED DAYS. This is the name of that brief but brilliant campaign fought by Napoleon I. after his escape from Elba, and ending in Waterloo. He arrived at Fontainebleau 20th March, 1815, to begin his campaign, and at the close of it he returned to the same place, and signed his abdication on 22nd June, 1815, ninety-four days later. He left there utterly crushed on the 29th of the same month—just a hundred days from the time he started under such apparently brilliant auspices.

HUNDRED MOTE or **HUNDRED MOOT** was the monthly local assembly of the whole hundred held by our ancestors before the Norman Conquest and for long after. It was convened by the hundreds-earldorman, and formed the "tribunal of first instance," as we should now call it. Suits had to be tried by the hundred mote before being taken to the shire mote or to a higher tribunal. Twelve of the inhabitants were chosen as judges, and had to present every guilty or accused person in the hundred to justice. They were, in fact, a jury of presentment, and the hundred mote survives in our grand-jury system. They had both civil and criminal jurisdiction.

Each hundred mote had to send a deputation to the shire mote or county court consisting of twelve men. It was itself made up of all the suitors summoned and of six chosen representatives of each township in the hundred—namely, the parish priest, the reeve (answering to our mayor), and four "best men" of that township.

HUNDRED YEARS' WAR is a name probably due, in the first instance, to the French historians, but now adopted thoroughly by our own writers, to express in one term that long struggle for the French crown which began with Edward III.'s claim upon it in 1339 and closed with the loss of every foot of English possessions in France (except Calais) in 1451—112 years later. There were three remarkable periods in this protracted conflict—that of Edward III., containing the victories of Crecy (1346) and Poitiers (1356); that of Henry V., containing Agincourt (1415) and the treaty of Troyes (1420), giving France over to England at the death of the then reigning king; and that of Henry VI., full of disasters to England, embracing the extraordinary career of Joan of Arc, the siege of Orleans in 1429, and the burning of Joan as a witch by the brutal English in 1431, an indelible blot upon our country's fame. From 1389 to 1399 the war with France fitfully slumbered, and in 1396 Richard II. married the French princess Isabella as his second wife in an endeavour to end the long contest, and a truce of twenty-five years was agreed upon. It was this faithlessness of the son of the Black Prince to his grandfather's policy which, as much as any of his other acts, cost him the affection of his people and his crown. His successor, Henry IV., reopened hostilities at once on his accession in 1399.

HUN'GARY, a country of Central Europe, formerly an independent state, but now constituting a part of the Austrian Empire, having been united to it on equal terms in 1867 under the name of the Transleithan Kingdom, to distinguish it from that portion of the empire which lies on the opposite side of the boundary river Leitja or Leitha, and which is called the Cisleithan Kingdom. In its widest sense Hungary includes, besides Hungary Proper, Transylvania, Slavonia, and Croatia, and the small territory of Fiume on the Adriatic. It is bounded on the N. and N.W. by the Carpathian Mountains, which separate it from Moravia, Silesia, and Galicia. On the E. and S.E. the Eastern Carpathians separate it from Roumania; on the S. the Danube, the Save, and the Unna divide it from Servia and Bosnia; Dalmatia and the Adriatic bound it on the S.W.; and Carniola, Styria, and Lower Austria on the W. It lies between 44° 30′ and 49° 35′ N. lat., and 16° and 26° 25′ E. lon.

The general character of the country is that of a basin, into which spurs of the encircling mountains descend so deeply that about one-third of the surface is occupied by them. Two great plains form this basin, the smaller of which spreads on both sides of the Danube between the

Bakonywald, which reach out to the bend of the Danube at Waitzen, and the Little Carpathians, which terminate at Pressburg. It has an area of about 6000 square miles. The greater plain is the largest in Europe, and extends over Central and Southern Hungary, with an area of about 37,000 square miles. This is known as the Pesth Basin or Great Hungarian Alföld, while the former is called the Pressburg Basin or Little Hungarian Alföld. The *fata morgana* is frequently to be seen in these immense tracts of low land. A great part is occupied by a clay soil of extraordinary fertility; but along the rivers large swamps occur, owing to their low borders being so readily overflown. There are also large tracts of sand, called *puzta*, interspersed with soda lakes, which dry up in summer and leave their beds incrusted with the mineral. From their general character they appear to have anciently belonged to the bed of an extensive inland sea. But both the sand and swampy tracts are rapidly diminishing in size in consequence of extensive works energetically carried on for their reclamation. As a rule these level tracts are unhealthy, but the climate in other parts is highly salubrious —severe in the north in winter, but towards the centre and south so mild that the fig, vine, chestnut, and other south European fruits are grown. The mean annual temperature of the centre is 54·5° Fahr., on either side of which there is a range of about 11° Fahr., the climate being somewhat extreme. The rainfall in the centre is 16 inches, and the number of rainy days 112.

The area and population are as follows:—

	Area in English Sq. Miles.	Population in 1881.
Hungary Proper, ...	87,043	11,644,574
Croatia and Slavonia, with military frontier, . . .	16,773	1,892,499
Transylvania (Siebenbürgen),	21,215	2,084,048
Town of Fiume, ...	8	20,981
Total, ...	125,039	15,642,102

The most elevated mountains of Hungary are in the northern sections of the kingdom. Commencing near Pressburg the Carpathians extend about 100 miles N.N.E. with an elevation of about 2000 feet, then turning east along the northern frontier they include the loftiest mountains of Hungary in the Tatra group, which, in the Ruska Poyau peak, attain an elevation of nearly 10,000 feet. Turning to the south they then form an extensive mountain district, with elevations in some cases attaining to 7000 feet. The Eastern Carpathians and Transylvanian Alps occupy the greater part of Transylvania. The frontier of the Banat towards Roumania and Transylvania is formed by the last offsets of the Carpathians towards the Danube. On the south side of the Danube, near Pressburg, are the Leitha Mountains, which form the boundary towards Austria, and are offsets from the Alps, as they subside from Styria towards the Danube. On the west Transylvania is divided from Hungary by a chain of low mountains, lying between the Szamos and the Maros, two rivers which flow west to join the Theiss. Though the summits of this chain nowhere exceed 3690 feet, it is yet extremely rugged and precipitous. The Julian Alps and their offsets cover Croatia and the Hungarian coast districts, the Capella and Villebich being the last branches of this range towards the south.

For water communication the country is almost entirely dependent on the Danube, which enters by the Porta Hungarica in the Leitha Mountains, 30 miles east of Vienna, and after passing along the southern boundary enters Wallachia near Orsova. It is navigable throughout the whole of its course through Hungary, and receives nearly all the other rivers either directly or indirectly. The Theiss, itself a branch of the Danube, is one of the chief rivers, and its basin may be considered as forming a distinct part of Hungary. The Drave, the Raab, the Leitha, the March, the Waag, the Gran, &c., flow into the Danube. The Zagyva, the Sajo, the Hernad, the Bodrog, the Koros, the Maros, the Gzemos, the Temes, &c., flow into the Theiss. Of the lakes the most considerable are the Platten See [see BALATON], 46 miles long and 3½ miles mean breadth, and the Neusiedler, about 24 miles long and from 3 to 7 miles broad, both of which lie in the west part of the country. Many canals have been made in different tracts of Hungary, partly to drain the marshes and partly for the purposes of commerce. The most important is the "Ferency" or "Francis." It is about 70 miles long, and connects the Danube and the Theiss by a shorter route than the natural outlet of the latter river. A great trunk line of railway by Pesth connects Vienna with Szegedin; it is continued to the Euxine, and there is a branch to Debreczin and Transylvania. The only important port by which Hungary has access to the sea is that of FIUME on the Adriatic.

In the abundance, variety, and value of its natural productions Hungary excels almost every country in Europe. Corn is the main product of agriculture, especially in the south. The Hungarian wheat is of the finest quality, and well known in the French and English markets. Fruit grows everywhere, even at the foot of the Carpathians. There are whole forests of cherry, plum, and chestnut trees. In the south lemon and orange trees blossom the whole summer in the open air. Barley and other cereals are grown for home use; several species of grape are cultivated, of which one, called the *formint* grape, is peculiar, and yields the celebrated Tokay wine. This is grown on the Hegyalla Hills on the Upper Theiss; the annual produce is very large, the vineyards covering about 1,350,000 acres. It is a common beverage all over the country, and the Magyar population are considered the most successful growers. In this branch of industry Hungary ranks next to France. Tobacco is an important product in the centre and south; it is reckoned very fine, and is largely exported. Hemp and rape are raised in the marshes.

Of domestic quadrupeds the horned cattle are some of the finest in Europe. The breed of sheep has been much improved, and horses, swine, and poultry are largely reared. Bears, wolves, and various birds of prey are met with in the forests. Live stock is extensively reared, vast flocks and herds of which range in nomad fashion over the wide prairie-like plains; and wool is an important article of export. The Theiss is reckoned the best fish river in Europe, and Hungary to have the greatest variety of insect life. Farming is not well understood, and is practised on defective methods and with most inferior apparatus. Here, however, the Slovacks have the advantage of the Magyars.

The manufactures are unimportant and chiefly for home use. Some woollens, silks, linens, and paper are made; leather extensively, the Hungarians being noted for their saddlery. The internal trade is mostly in the hands of the Jews, of whom the country contains about 300,000. There are three principal mining districts—Schemnitz, near the Königsberg group of mountains in the north-west; Schmolnitz, on the same parallel further east, in the county of Zips, south-east base of Tatra group; Telkebanya in the Hegyalla Hills near Tokay, Nagybanya on the north frontier of Transylvania, and the Bannat, east part. By far the most important district is that of Schemnitz. Here gold and silver occur in limestone traversed by trachyte and other igneous rocks; but the mines of Nagy-banya are richer in gold; other metals are associated with these. Indeed, all the metals except tin occur more or less abundantly in different parts of Hungary. Half the gold

and silver found in Europe is raised here and in Transylvania, and the copper mines (chiefly Schmolnitz) are second only to those of England. Rock-salt occurs in several places, and soda is largely obtained from "the White Lakes" of the great plain. A curious circumstance is the quantity of nitrates of potash found in the springs and wells, while it is impossible to trace the origin of the salt to any organic deposits. Precious opal and other gems occur in pearlstone porphyry rocks at Czernowitza in the Hegyalla Hills north of Tokay, and a few other places. Coal-beds, associated with sandstone and rich ironstone, occur between the Theiss and frontier of Transylvania. Iron, however, is very widely distributed, and coal is also found in other places.

The constitution of Hungary dates from the foundation of the kingdom, about 895. There exists no charter or constitutional code, but in place of it are fundamental statutes, published at long intervals of time. The resemblance to our own constitution in this respect is most remarkable. The principal of them, the "Bulla Aurea" of King Andrew II., was granted in 1222, and defined the form of government as an aristocratic monarchy. The Hungarian constitution has been repeatedly suspended and partially disregarded, and at the end of the armed struggle of 1849 it was decreed by Austria to be forfeited altogether by the rebellion of the nation. This decree was repealed in 1860, and the Emperor of Austria, on the 8th of June, 1867, swore to maintain the restored Hungarian constitution, and was crowned King of Hungary.

The legislative power rests conjointly in the king and the Diet or Reichstag. The latter consists of an Upper and a Lower House, the first known as the House of Magnates and the second as the House of Representatives. The House of Magnates was composed, in 1885, of 831 members—namely, two princes of the reigning house; fifty archbishops, bishops, and other dignitaries of the Roman Catholic and Greek churches; 772 peers and dignitaries of Hungary and Transylvania; five regalists from Transylvania; and two deputies of Croatia. The Lower House, or House of Representatives of Hungary, is composed of representatives of the nation, elected by the vote of all male citizens of twenty years of age who pay a small direct tax on house property or land, or on an income varying with occupation, but in all cases very low (in the case of merchants and others as low as £10 5*s*.) Certain large classes—professional, scientific, learned, and others—are entitled to vote without other qualifications. The number of the electorate, according to the last returns, was only 840,000, or one in eighteen of the population. No distinction is made, either as regards electors or representatives, on account of race or religion. New elections must take place every three years. By the electoral law in force in the session of 1885 the House of Representatives consisted of 444 members, of whom 334 were deputies of Hungarian towns and districts, seventy-five from Transylvania, thirty-four delegates of Croatia and Slavonia, and one from Fiume.

Since the constitutional settlement with Austria, made in 1867, the revenue and expenditure of the country have undergone a remarkable expansion, the expenditure having been, in fact, largely beyond Hungarian means. Railways and other heavy public works have been carried out without due regard to a prudent economy, and ruinous loans have been undertaken to meet the constant deficits. The expenditure of 1884, for instance, was £33,000,000, against a revenue of only £31,000,000. The debt amounted to £120,000,000 in 1885, in addition to which Hungary has to contribute over £3,000,000 per annum to the debt of Austria contracted before 1868, since which all loans have been contracted separately by either country. The charge for the debt in Hungary is nearly 40 per cent. of the whole revenue.

Perhaps no country of the same extent contains such a variety of nations as Hungary. The Magyars, or proper Hungarians, were originally Tartars (Turanian); there are also Wallachians, Armenians, Germans, Italians, Jews, Servians, Russniaks, Slovacs, Croats, and Wends. More than half of the Magyars hold Calvinistic doctrines; the rest are chiefly Roman Catholics. The Roman Catholics have three archbishops and seventeen bishops. The United Greeks have four bishops. The Non-united Greeks have an archbishop and seven bishops. The Protestants are governed by superintendents and synods.

Education is compulsory and schools exist in every district. There are also a few academies, many gymnasia, a lyceum at Erlau, a university, and two schools for philology at Pesth, a famous mining school at Schemnitz, and many others.

History.—The oldest known inhabitants of Hungary were a nation of nomadic barbarians of Turanian origin, who about A.D. 375 poured in a fierce torrent upon Europe from their then home in Scythia or Western Tartary. The Romans called them HUNS. They conquered all before them, and under ATTILA, their greatest king (434 to 453), they ruled from Gaul to China. But though from 377 onwards, and more especially after the break-up of Attila's empire in 453, Hungary (then Pannonia) formed their central home, the Huns did not give their name to it. This comes from the later invasions of the *Ungri* and *Magyars* in the tenth century. The Huns of Pannonia were conquered by the *Gepidæ* (Goths) of Dacia in 489, and by the *Lombards* (Teutons) in 526, and presumably the Turanian element sank low. It was revived by a fresh Tartar invasion, that of the *Avars*, in 568, and Pannonia now took on a settled Turanian character. Charles the Great in 796 ended a bitter and successful war against this heathendom which had entrenched itself in Mid Europe. But a fresh invasion of Tartars, the allied tribes of the Ungri and the Magyars (or they may be one tribe under a double name), arrived in these parts from Asia about 890; and the Avars, who had with difficulty been kept in some sort of subjection by the emperors succeeding Charles, at once made common cause with the fierce new-comers. The Ungri were a wild race, who made a desert of any country they conquered, and were as brave as they were savage; they fought on horseback, and the foot-soldiers of the Germans were powerless against them, so were mown down like grass. Hungary became so thoroughly Tartar that its very name of Pannonia disappeared in favour of that of the terrible Asiatic barbarians, and these latter were only kept from subduing Germany itself by the most heroic efforts, often repeated, of the Germans of the march or border. The chief who had led them from Asia was named Almos, and on his death in 889 his son Arpad succeeded without opposition. The latter was just the man the occasion required, with sufficient of the savage to maintain his supremacy, but on the other hand clever enough to appreciate the higher civilization to which he had now penetrated. It is to Arpad that the Hungarians look as their founder, and with truth, for he made them into a nation. He welded the seven original tribes into a tolerably homogeneous whole, enlarged the conquered lands sufficiently to give the new nation room for development, and caused himself to be recognized by the emperors as duke of the country. His son Zoltan succeeded him in 907, and Taksony, son of Zoltan, succeeded in 947. Further attempts at conquest were checked by the emperors; Zoltan was defeated by the Emperor Henry I. in 933, and Taksony by the Emperor Otho in 955. After this the Hungarians ceased to endeavour to enlarge their boundaries, already sufficiently wide. The Arpad dynasty had now become firmly hereditary, and its rule lasted altogether over four centuries. At Taksony's death in 972 his son Geyza succeeded, and he brought Hungary still more closely into the ranks of European

nations by marrying a Christian princess and himself becoming a Christian in 975. Stephen, son of Geyza, was proclaimed king in the year 1000 by the pope. He married the sister of the Emperor Henry II. Bitter religious feuds marred his otherwise successful reign. For his support of the church he received canonization as St. Stephen of Hungary. His legislation was enlightened; he founded a national council composed of greater and lesser barons and of spiritual as well as lay peers. A century later a monarch of similar views, St. Ladislaus, by his genius and virtue, irradiated a period of Hungarian history which otherwise would present only a dark record of war and bloodshed. He subdued Slavonia and Croatia in 1089. Coloman, his nephew and successor, conquered Dalmatia in 1102. The boundaries of the kingdom were later on still further extended by Bela II. and Emerich, the former of whom subdued Bosnia (1138) and the latter Servia (1196).

A valuable impetus was communicated to the prosperity of Hungary by the introduction in 1148, under the auspices of Geyza II., of German colonists, who laid the foundation of its manufacturing wealth; and the gradual progress of commercial and industrial ideas exercised a favourable influence on the Magyars, who abandoned their wild rude life on the tented plain, and assembled in towns under the shadow of the law. The "Golden Bull," the Magna Carta of Hungary, was extorted from King Andrew II. in 1222, curiously near the date of the corresponding foundation of popular liberty in England (1215), and Hungary began to flourish. The Golden Bull, to which all succeeding kings had to swear fidelity, granted annual Parliaments, the right of legal trials for alleged offences, freedom from taxation of land for the nobles, and the right of armed resistance to the sovereign if he attempted to overstep his rights. This last curious proviso remained in force till 1687. A severe blow, however, was given to the national welfare by the terrible irruptions of the Mongols, beginning about the middle of the thirteenth century, and it required a long course of years to heal the wounds inflicted by those barbarous hordes. The Tartars, fierce as the Hungarians themselves had been before their civilization, made their first great raid in 1241–42, massacring whole villages and devastating the land with fire and pillage. Bela IV., though utterly unequal to resist the savage onslaught, did the next best thing after the Tartars had retired gorged with plunder: he invited colonists from Germany and from other surrounding countries to enter freely and repeople the barren land. Unfortunately, just as Hungary began to revive, Bela was drawn into the German dynastic conflicts, and much misery ensued. His son Stephen took occasion to set himself at the head of the malcontents; and finally, as if to crush the unhappy country, the dreaded Mongols broke upon the land once more in 1261. Taking courage from his desperate state, Bela faced his old foes, and was able this time to drive them back with complete success, and to restore some approach to order in his troubled kingdom. The interference in German affairs, so fatal to Bela IV., was continued by Stephen V. (1270) and Ladislaus IV. (1272), each of whom made war on Ottocar of Bohemia, the most powerful prince of Germany, in support of the Emperor Rudolf, a petty Swabian count of Hapsburg, who had been made emperor because he was supposed to be least likely to interfere with the great princes. But Rudolf so firmly seized the reins of power and so strengthened himself with alliances (such as this with Hungary) that he was able not only to found the great house of Austria, but so to order things that the empire became hereditary in the Hapsburg family. Andrew III. was the last monarch of the Arpad dynasty, which became extinct at his death in 1301.

Kings of the Arpad Dynasty.—St. Stephen (descendant of Arpad, first duke of Hungary), created king by Pope Sylvester II., 1000; Peter (nephew of Stephen's queen), 1038; Andrew I., cousin of St. Stephen, 1047; Bela I., brother, 1061; Solomon, 1063; Geyza I., 1074; St. Ladislaus, 1077; Coloman, nephew, 1095; Stephen II., son, 1114; Bela II., son, 1131; Geyza II., son, 1141; Stephen III., son, 1161; Bela III., son, 1173; Emeric, son, 1196; Ladislaus III., son, 1204; Andrew II., brother, 1205; Bela IV., son, 1235; Stephen V., son, 1270; Ladislaus IV., brother, 1272; Andrew III., son, 1290.

A disastrous interregnum ensued, which was terminated by the interference of the papal power on behalf of Charibert (Charles Robert), a prince of the Sicilian house of Anjou, and grandson, by his mother's side, of King Stephen V. Charibert gained his crown by the sword (1307) and preserved it by the sword, recovering the provinces which the kingdom had lost, and adding to it Moldavia. Louis I. (1342–82), son of Charibert, added Dalmatia and Poland to Hungary. His surname of "the Great" is even better deserved by his fatherly care for the welfare of his subjects. It was his brother Andrew who was the victim of the infamous Joanna I. of Naples, whom he had married, and Louis sent a brilliant expedition into Italy in 1380 to avenge his brother's murder. Joanna submitted to his general and nephew, Charles of Durazzo, and was strangled in prison, 1382. Charles had hardly been crowned King of Naples when the death of Louis called him into Hungary to claim the crown. Instead of a crown he met with assassination. The same year (1386) Sigismund, margrave of Brandenburg, married Maria, daughter of Louis the Great, who had worn the troubled crown since her father's death. Sigismund was formally acknowledged king in 1392, and soon became one of the most powerful princes of the time. In 1401 he was put into prison for evading the constitution, and remained there six months, and he was also actually deposed in 1403; but on both occasions he managed to recover his crown and the good-will of his subjects, and quickly to become more powerful than before. He was elected Emperor of Germany in 1410. He has the shame of breaking his safe-conduct and sacrificing Huss and Jerome of Prague; but he carried through the Council of Constance (1414–18), called to heal the schism in the church, visiting Spain, England, and France in his unwearied efforts, which well deserved the entire success they attained. On the death of his brother Wenceslaus in 1419 Sigismund claimed his kingdom of Bohemia, and sought at once to gain the crown and to extirpate the heresy of the Hussites. The terrible religious wars which ensued made Bohemia almost a desert. Sigismund did not succeed in finally conquering the Hussites till 1434. He died in 1437. In 1415 he sold his margravate of Brandenburg, with the dignity of elector of the empire, to Frederick, count of Hohenzollern, for 400,000 Hungarian gulden; and this was the foundation of the present royal house of Prussia. Sigismund was succeeded by his son-in-law, Albert II., duke of Austria, who not only became King of Bohemia and Hungary but emperor as well, thus laying the foundation of the imperial rule over Hungary of the dukes of Austria, which lasted till the last male died out in the father of Maria Theresa. His son, Ladislaus V. of Hungary, was born after the death of his father (1439); the empire therefore passed from Hungarian hands, and Wladislas of Poland was elected king, 1442. The Turks had been pressing upon Hungary in Sigismund's reign; indeed he had to flee for his life before them in 1396. In Hunyadi Janos (John Hunyady) they met a different foe. He soon gained a ten years' truce, and on their breaking faith utterly routed them at Varna in 1141. King Wladislas fell, and Hunyady was chosen "protector." When Ladislaus V. came to his own he very wisely continued the great Hunyady in his command of the army. In 1456 the famous Mohammed II., flushed with success by the fall of Constantinople (1453), appeared before Belgrade with 150,000 men. Hunyady, though he only led 70,000, obtained a glorious victory and saved Europe. On

the death of Ladislaus V. in 1457 his relative the emperor (Frederick III.) claimed the whole realm, but obtained only Austria. Bohemia elected Podiebrad as king, and Hungary the valiant Matthew Corvinus, son of John Hunyady. Matthew (1458–90) was the greatest of all the Hungarian kings. His first care was to thoroughly reorganize the army and to clear the land of its hereditary enemies, the Turks. He then raised the Catholic standard against the Hussites of Bohemia, 1468, and so victoriously as to warrant his coronation as King of Bohemia at Olmütz in 1469. But the Turks were not idle, and took advantage of his absence to reoccupy their former positions in the south of Hungary. Further, discontent arose at the neglect of the primary concerns of the kingdom for the sake of glory. But King Matthew swiftly returning first restored order, and then in a most sanguinary battle (1479) annihilated the Turkish forces. The death of Mohammed II., the great warrior sultan (1481), freed Hungary at last from the incessant and harassing frontier warfare. Afterwards, a cause of quarrel arising with Germany, Matthew twice vanquished the Emperor Frederick IV. in battle, and indeed in 1485 he took and occupied Vienna, and for a short time made it the seat of his government. After the death of Corvinus Hungary sank from the brief enjoyment of the proud position to which he had raised her, not only of the leading military power, but the home of the most advanced learning of Europe at the time. The famous Corvinus library contained 10,000 precious Greek manuscripts saved from the spoils of the Turks. Under Louis II. (1516–26) the continual efforts of the Turks, so long held at bay, could no longer be resisted by the kingdom, which was torn by internal dissensions. Led by Solyman the Magnificent, the Moslems completely annihilated the Hungarian forces at Mohacs in 1526. Louis II. was slain, and when the victorious soldiers of the crescent withdrew from the ravaged land, they bore with them 200,000 Christian captives into slavery.

In 1526 one party elected the Archduke Ferdinand (afterwards the Emperor Ferdinand I.) to the Hungarian throne, but another party elected John of Transylvania, who basely allied himself with the Turks; and the country long remained disturbed by the enmities of the Protestant and Catholic factions, while the Turks held many of its principal strongholds till about 1530, when they retired, and Ferdinand was generally acknowledged. The succession of the sovereigns of Hungary now becomes the same as that of the dukes of Austria—that is, the emperors of Germany—and in 1687 it was declared hereditary in the house of Hapsburg. [See GERMANY.] For a century and a half longer, as the bulwark of Christendom, the frontier land between Christian Europe and Mohammedanism, Hungary was subject to Turkish invasions, which drained it of its best blood and exhausted its resources. When the coalition of France, Bavaria, and Prussia threatened the Empress Maria Theresa with the loss of all her dominions, the loyal Magyars drew their swords in her cause with the shout of "Moriamur pro nostro rege Maria Theresa." She died in 1780, and was succeeded on the Hungarian throne by her son, Joseph II., emperor of Germany. In 1790 Peter Leopold became emperor and king, and on his death in 1792 his eldest son, Francis, assumed the crowns.

During the long wars of Napoleon the Hungarians ungrudgingly contributed their men and money to the defence of Austria and the empire, the Diets being convoked for no other purpose than to grant supplies and be dismissed as soon as they spoke of grievances. But when Napoleon's power was crushed on the field of Waterloo, they naturally expected as a recompense for their sacrifices the social and constitutional reforms which the kingdom greatly needed. To secure them the Hungarian party was formed in 1827.

In 1847 the direction of this patriotic party lay with Louis Kossuth, a man of genius, political sagacity, and courage, who, gifted with extraordinary powers of eloquence, soon obtained a vast ascendency over the minds of his countrymen. Under his leadership the Hungarians demanded a responsible ministry, freedom of the press, and annual diets or parliaments. The French revolution of 1848 shook nearly every European throne, and the Emperor Ferdinand was in no position to disregard the voice of bitterly-wronged Hungary. He conceded all she asked, and for the first time for three centuries the Magyars beheld at Pesth a truly national government.

As soon as Austria had shaken off her first alarm, she began to consider how she should undo what she had done, and recall the liberties she had reluctantly granted. For this purpose she secretly encouraged Jellachich, the ban of Croatia, to invade Hungary with his Serbs and Croats, hoping to profit eventually by the successes he might gain. Discovering the imperial designs Hungary prepared for war, and the Diet voted funds for raising an army of 200,000 men. Both parties now stood unmasked. The emperor loaded favours upon Jellachich, who crossed the southern frontier of Hungary on the 9th of September with an army of 60,000 men. On his approach to Pesth he was met by the Hungarian volunteers, strong in the consciousness of a just cause, and suffered a total defeat. In December, 1848, Ferdinand abdicated in favour of his nephew, Francis Joseph.

The imperial authorities now threw themselves actively into the struggle. They dissolved the Diet, appointed Jellachich military governor of Hungary, and declared the whole kingdom under martial law. The troops of Austria were poured into the country in the belief that the rebellion would be speedily crushed. One hundred and thirty thousand men, under Prince Windischgratz, constituted, indeed, a force to which, at first, the Hungarians could offer no resistance, and town after town fell into the hands of the Austrians. The Diet then retired to Debreczin; and Görgei, the commander-in-chief of the Hungarian levies, concentrated his army behind the Theiss. Elate with fond hopes, the emperor now issued a proclamation on 4th March, 1849, declaring the national existence of Hungary terminated; as a corollary to which startling proposition, Görgei suddenly led his troops across the Theiss, dashed upon the Austrians, and in a series of engagements which extended over ten days drove back the enemy from point to point, until he finally crushed them at Godollo. Windischgratz was immediately removed from his command, and his successor evacuated Hungary with the wrecks of the imperial army.

On the 16th of April the Diet declared Hungary independent and appointed Louis Kossuth governor. This step appears to have wounded the *amour propre* of Görgei, though he offered no open opposition. Had he immediately marched upon Vienna he would assuredly have secured his country's freedom; but he elected to move towards Buda, and afforded Austria time to summon her troops from Italy and to invoke the aid of Russia. In the month of June the combined imperial armies poured into Hungary from north and south, from east and west. An attack, however, which they hazarded upon Görgei's intrenched camp, near Komorn, was repulsed with a loss of 3000 men; and it is probable that his great military talents might still have been exerted on his country's behalf, but for his sudden and ill-advised removal from the post of commander-in-chief. It is true that in the following August Kossuth and his colleagues retraced their steps by placing the sole power in his hands as Dictator of Hungary; but for reasons which have never been quite satisfactorily explained, and on which there are some differences of opinion, ten days subsequent to his elevation he unconditionally surrendered his whole army, 32,000 men, with 144 pieces of artillery, to the Russian commander at Villagos.

There was now no resource for Hungary but submission. The leading nobles solicited the emperor's clemency; Kossuth, Bem, Guyon, and others, too closely implicated in the rebellion to expect any mercy, made their way into Turkey. Austria pressed for their surrender; but the Ottoman government, supported by England and France, resisted the demand; and Kossuth afterwards repaired to England, where he was enthusiastically welcomed. It was doubtless the remembrance of the honourable conduct of Turkey in 1849 which gave such a strong inclination of Magyar sympathy towards Turkey in 1877.

Komorn, the last stronghold of the Hungarian patriots, capitulated in October, 1849, and the whole of Hungary bowed beneath the Austrian yoke.

It may not perhaps be for the interests of Europe that Hungary should have an existence separate and distinct from that of the Austrian Empire, but every lover of liberty sympathized with her efforts to secure a constitutional government and the restoration of rights guaranteed to her by the very treaty which conferred her crown on the house of Hapsburg. What she failed to obtain by force of arms, she afterwards obtained from Austria's necessities. The catastrophe at Sadowa in 1866 opened the eyes of the emperor and his advisers to the fatal weakness of the empire, and it became their first care to effect a durable reconciliation between the crown and its Hungarian subjects. On 8th June, 1867, the emperor was crowned at Pesth as King of Hungary, with a pomp and enthusiasm which recalled former and happier times, and took the oath of allegiance to the Hungarian constitution. All the principal demands of the Hungarian constitutionalists were conceded by the Austrian cabinet, and the country obtained the control of her own finances and militia, her rights of local self-government, her own Diet, and separate administration. In all matters of internal government Hungary was made both theoretically and practically independent of Austria. Since that time the arrangement has worked fairly harmoniously. The only serious difficulty between the two kingdoms of the dual empire arose during the Russo-Turkish War, when the Hungarians were with difficulty restrained from active interference in favour of Turkey. Great internal agitation was caused in 1879 by the passing of an education decree ordering the state language to be taught in all non-Magyar elementary schools.

The full-dress costume of the higher classes in Hungary is celebrated for its picturesque elegance, and has been copied more or less in the dress of all the hussar regiments in Europe. There are various others little less remarkable among other classes of the people.

Language.—The Hungarian language occupies a very curious position. It is a Turanian or Scythian tongue thrust forward from the Southern Ural district within European times, and oddly surviving in the midst of the totally unrelated Indo-European (or Aryan) tongues which surround it. It has closely allied branches in the north of Europe, where other Tartar invaders occupied Finland, Lapland, Esthonia, and Livonia, and the tongues of these regions are varieties therefore of Hungarian. Of course there are also the remnants of the original settlements in the Southern Urals, as the Ostiaks, Woguls, &c. The nearest branch to this Finno-Hungarian group is that of the Samoyeds of Northern Asia, and the third and most numerous group is that of the Turkish or Tartar people.

Hungarian literature dates back (but only in fragments) to the close of the twelfth century, but the active literature is not older than the beginning of the seventeenth—the Finnish literature beginning about a century earlier. Latin was used for literary purposes by the Hungarians in preference to their own tongue. A revival of the use of the native language, however, began about 1772, and Hungary has produced numerous distinguished writers who have proved that their native language was undeserving of the neglect with which it had been treated. The names of the poets Alexander Hisfaludy, Andréos Horváth, Alexander Petöfi, and John Arany, are all well known, and the talents of Maurica Jokai, as a novelist, have gained him a European reputation.

The Turanian tongues are agglutinative in structure; that is to say, each root keeps itself unaltered, and language is made by tacking words together. (Our own plan is to use inflexions; we do not say *I did bring*, but *I brought;* we alter or inflect the word to obtain a variety of meaning in the general idea *bring*). And not only do these agglutinative languages thus crowd root-words together, but they do so in masses which are as unwieldy as a German compound word. Thus from the root *sev* (love) in one of them we may make the intricate derivative *sev-ish-dir-il-e-me-mek*, which means "not to be capable of being made to love one another," and this may be conjugated all through, like any other verb. It is no wonder, with a tongue of this kind, that Hungarians are such extraordinary linguists; for if they learn their own language all other tongues must seem child's play to them.

HUNGARY WATER, a celebrated alcoholic perfume, chiefly employed for toilet purposes, but which is sometimes taken internally as a stimulant or used externally as a liniment. It was formerly known as *Queen of Hungary's water*, from a legend which ascribed its origin to a recipe given by a holy hermit to a queen of Hungary in the fourteenth century. There are now numerous recipes given for its preparation, a good one of which is as follows:—Take a pound of fresh rosemary in blossom and an ounce and a half of fresh sage in blossom, and cut them in small pieces; add half an ounce of crushed ginger, and place the whole in 3 lbs. of rectified spirits diluted with half a pint of water; of this slowly distil at a sand heat about 3 pints.

HUNGER is one of those states of mind or sensations denominated *appetites*, which is the generic name we give to the uneasy feelings produced by the recurring wants of the organic system. Of these the most powerful are sleep, hunger and thirst, and sex.

Hunger is the desire for food, arising without doubt from a deficiency of food in the system. The seat of the appetite is the stomach, and the popular idea of the cause of the sensation is that it arises merely from emptiness of the stomach. That this is a fallacy, however, can be shown easily, since hunger can be effectually removed by the introduction of food into the body in other ways than by the stomach. Or it may be shown by cutting the great gastric nerves (pneumogastric), which if hunger were a stomach-sensation would of course destroy it (in the same way as cutting the optic nerve destroys sight), but which on the contrary does not affect it: hunger recurs at the proper interval though the stomach cannot feel anything, and not only so, but it is referred to the stomach as the seat of pain.

It must be admitted, however, that the emptiness of the stomach, though not the sole cause of hunger, is yet very greatly concerned in it; for if non-nutritious substances be swallowed the pains of hunger are much mitigated, and some savages eat clay for this purpose. It would seem, then, that we should assign as the cause of hunger a deficiency of fresh nutritive matter in the system in general, and as regards the special stomach-pain a long continued emptiness of the stomach.

But this, though describing the meaning of hunger, does not tell us the cause of the pain. For the moment science is powerless to decide on the latter. One explanation is that the walls of the stomach rub together and the pain is caused by the friction, which is absurd; for the stomach is empty after every meal long before hunger is felt, and is sometimes empty for days without hunger being felt, as in cases of illness. Another notion is that the gastric juice attacks the walls of the stomach itself instead of the food which ought to be there for it to attack; this suffers under

a rather fatal objection—namely, that the gastric juice only begins to be secreted upon the reception of food into the stomach. Again there is a theory that hunger is caused by the slow secretion of the gastric juice in the follicles of the stomach to the point of distension, since unless the proper stimulus of some substance in the stomach be given the follicles will not discharge themselves. This distension, when moderate, gives a pleasant appetite; when strained, a craving hunger. The theory fails, however, because food supplied to the blood, whether injected into the veins or the intestines, or absorbed (as in the case of milk baths) through the skin, would leave the follicles of the stomach distended as before, and yet it is known to dissipate hunger effectually.

The fact is that just as the eyes are the seat of sleep, but refreshing the eyes with bathing will not relieve the exhaustion, because that does not lie in the eyes alone, so the stomach is the seat of hunger, but filling the stomach (as with clay, &c.) will only refresh it for the moment, but cannot cheat the body, which remains as exhausted as before. And further, just as anything which powerfully rouses the attention will restore vigour to the eyes, so nourishment of the body will restore comfort to the stomach, although eyes have not been shut nor stomach filled. The full elucidation of the operation of hunger is still waiting a discoverer.

HUNGERFORD, a market-town of England, situated partly in the county of Berks (in the south-west) and partly in that of Wilts, is 61 miles from London by the Great Western Railway. It stands on the river Kennet and the Kennet and Avon Canal. The town consists chiefly of one long street. There are no manufactures, but there are some breweries and a considerable traffic arising from the railway and canal. The church, which is in the western quarter of the town, was erected in 1814. Near the church is the free grammar-school. The Kennet is here divided into two streams, one of which passes through the town, the other close by it on the north side. The latter is crossed by a bridge at the entrance of the town from Newbury. A town-hall and corn exchange were erected in 1870. The surrounding country is picturesque, and very good for hunting. Hungerford is also resorted to by anglers, as the Thames and Kennet are famous for their trout and strictly preserved. The population of the parish in 1881 was 2965. It was anciently called *Ingleford Charman*, from its position as the ford of the Angles on the Herman Street, an ancient Roman road.

HUNS or **HUNNI,** the name given by historians to several nomadic Scythian tribes which devastated the Roman Empire in the fifth century. They inhabited the plains of Tartary near the borders of the Chinese Empire for several centuries before our era, and it was to put a stop to their incursions that the Chinese built their Great Wall, about two centuries before Christ. In after-times they became divided into the Northern and Southern Huns. The Northern Huns, being defeated by the Chinese about A.D. 93, emigrated westward as far as the Volga, where they defeated the Alani. They then encamped in the plains between the Volga and the Tanais, and as far south as the ridge of the Caucasus, where they remained for more than two centuries. Under the Emperor Valens they first crossed the Cimmerian Bosphorus, drove before them the Ostrogoths and Visigoths, and obliged the latter to cross the Danube, when the emperor granted them lands in Thrace. The Huns had frequent wars with the Romans. [See ATTILA.] After the death of Attila, their greatest chief (reigned 434–453), the various tribes under his sway quarrelled among themselves, and being attacked by the Goths they were driven back beyond the Tanais. Part of them settled in Pannonia, to which they gave the name of Hungary; but the present Hungarians, or Magyars, came from a different immigration—in the tenth century.

HUN'STANTON, a town of England, on the coast and in the county of Norfolk, 114 miles from London by the Great Eastern Railway. It has long been known as a pleasant watering-place, the sands being firm and good and offering every facility for bathing. The principal buildings are the church, dating from about 1330; and the hall, long the seat of the L'Estrange family, and built in part about the time of Edward IV. There is a stone cross in the newer part of the town. A lighthouse, built in 1840, throws a splendid light, and is so arranged that a special red gleam is thrown on a sandbank called the "Roaring Middle." On the cliffs are the ruins of St. Edmund's Chapel, where St. Edmund, afterwards elected king of East Anglia, is said to have landed, and, in pursuance of a vow, shut himself up till he had learned all the Psalms by rote. The population of the parish in 1881 was 1516.

HUNT, JAMES HENRY LEIGH, a celebrated poet, essayist, and critic, was born at Southgate, in Middlesex, on 19th October, 1784. He received his education at Christ's Hospital; and his poetical talent displayed itself at such a singularly early age that before he left school he had written a somewhat large number of verses, which his father published by subscription in 1801, under the title of "Juvenilia." Hunt next became clerk to his brother Stephen, an attorney, and then a clerk in the war office, which he left in 1808, and became editor and part proprietor of the *Examiner* newspaper, which had just been started by his brother John. They were both tried for political libel in 1811, acquitted, but tried again, and sentenced to pay a fine of £500 and to undergo two years' imprisonment. The libel consisted of the term "a fat Adonis of fifty" as applied to the prince regent. After the expiration of the term he published in 1816 his "Story of Rimini," a poem which, though bitterly reviled by the critics of the period, possesses great merit, and served in the end to greatly modify the accepted standards of literary composition. He also continued to write for the *Examiner*, which was long the most ably edited and independent of the weekly metropolitan press. Hunt's editorship brought him into contact with several of the leading literary men of the day; and among the authors whose acquaintance he formed were Campbell, the two Smiths, Keats, Shelley, Coleridge, Hazlitt, Lamb, and Byron. In 1821 a new phase opened in Hunt's career. At Byron's invitation Hunt determined to transfer the *Examiner* to other hands, and to proceed to Italy with a view to establishing, in conjunction with the author of "Childe Harold," Hazlitt, and others, a journal in the interest of reform, to be christened the *Liberal*. Four chapters of his "Autobiography" are devoted to an interesting narrative of his Italian experiences, and a good deal of space is occupied by gossip and anecdote. He remained in the peninsula four years, a portion of which time he and his family spent under Lord Byron's roof, and the juxtaposition was attended, as might have been expected, by occasional jars. On his return to England, Hunt resumed his literary labours, chiefly in the shape of contributions to serials, and in periodical works, some of which were his own speculations. Among these were the *Literary Examiner*, 1817; the *Companion*. 1828; the *Tatler*, 1830–32; and the *London Journal*, 1834–35; and his talents gradually introduced him to the notice of persons able and willing to serve him. Before his visit to Italy he had published Nos. 1 to 4 of a quarterly review called the *Reflector*, and 100 numbers of the *Indicator*, 1819–21.

His other principal works are—a translation of Redi's "Bacchus in Tuscany," written during his stay in Italy; "Lord Byron and his Contemporaries," a work which gave great offence to the friends of Byron (1828); "Sir Ralph Esher," a romance of the period of Charles II. (1832); "Captain Sword and Captain Pen," a poem (1839); "The

Legend of Florence," a play (1840); "The Palfrey," a narrative poem (1842); "Imagination and Fancy" (1845); "Wit and Humour" (1846); "Men, Women, and Books," a collection chiefly of his earlier writings (1847); "A Jar of Honey from Mount Hybla" (1847); his "Autobiography" (1850); and "The Religion of the Heart" (1853).

During the early and middle portions of his life Hunt was frequently involved in pecuniary difficulties, and he always displayed a peculiar helplessness in money matters. In one of his periods of distress he was relieved by the lavish generosity of Shelley, and in 1844 he was further benefited by receiving from Mrs. Shelley and her son an annuity of £120. In 1847 Lord John Russell procured him a pension on the civil list of £200 a year, and these additions to his income enabled him to pass the later years of his life in tranquillity and comfort. He died 28th August, 1859.

His reputation as a writer rests chiefly on his poems and essays, the former of which are marked by animation, tenderness of sentiment, and metrical harmony, while the latter display, along with the simplicity and grace of their style, much delicacy of criticism, genial humour, and a determined cheerfulness which always looks on the bright side of things.

In 1870 a tasteful memorial bust of Leigh Hunt was erected by public subscription in Kensal Green Cemetery, where his remains were interred.

HUNT, WILLIAM HENRY, a water-colour painter, the small size and unpretending nature of whose works give no criterion whatever of his merit, was born in Long Acre, London, in 1790, and died in 1864. He was apprenticed for six years to the delightful water-colour artist John Varley, and almost at once made his mark as a painter of marvellous skill in colour harmonies, arranged with the rarest and subtlest taste, amounting to genius. No more remains to tell of his simple busy life. In 1880 a loan collection of Hunt's works (together with the noble architectural drawings of Samuel Prout) was held at the Fine Art Society's gallery in Bond Street, and to this a memorable set of "Notes" was drawn up by Mr. Ruskin, which ranks deservedly among the finest pieces of art-criticism ever penned. This little book set the seal on Hunt's fame. His works are now eagerly sought, and our state galleries esteem themselves fortunate in possessing a few. A bit of mossy bank, with a bird's nest and two or three eggs, or a butterfly resting on a tuft of grass, or a root of primroses in bloom, these are the subjects Hunt loved; yet Ruskin says of him (and with but little exaggeration), he is "all modern painters in a nutshell of a sentence, and the painted nutshell perfect," and elsewhere, "Take him for all in all, he was the finest painter of still life that ever existed. His art has every great quality save boldness."

HUNTER, JOHN, an illustrious physiologist and surgeon, was born in 1728 at Long Calderwood, a village near Glasgow, where his father possessed a small farm. Being the youngest of ten children, and his father dying when he was young, his education was almost entirely neglected. His whole time was devoted to the amusements of the country till he was seventeen years old, when he went to stay with his brother-in-law Mr. Buchanan, a cabinet-maker at Glasgow. Hunter worked at the trade for nearly three years. At the end of that time, hearing of the great success which his brother [see HUNTER, WILLIAM] had met with in London as an anatomical and surgical lecturer, he wrote to offer him his services as assistant in the dissecting rooms. His offer was accepted, and in 1748 he commenced his anatomical studies, in which he at once distinguished himself both by his ardour and his skill. In 1749 Hunter became the pupil of Cheselden, then surgeon to Chelsea Hospital, which he attended for nearly two years, and in 1751 he went to St. Bartholomew's Hospital, and attended the practice of Mr. Pott. In 1753 he entered as a gentleman-commoner at St. Mary's Hall, Oxford, intending to practise as a physician; but he seems soon after to have given up this idea, for in 1754 he entered as a surgeon's pupil at St. George's Hospital, in the hope of becoming at some future time a surgeon at that institution. In the same year his brother made him his partner in the school, and he delivered a part of each annual course of lectures till 1759, when his constant and severe labours in anatomy, to which he had lately added comparative anatomy and physiology, began to affect his health so seriously that it became advisable for him to resort to some milder climate. With this view he obtained an appointment as staff-surgeon, and early in 1761 proceeded to Belle-Isle with the armament ordered to lay siege to that town. He afterwards went to Spain, and remained in active duty till the end of 1763, when a peace was negotiated, and, his health being completely restored, he returned to London and commenced practice.

At first Hunter met with little success in his profession. His manners were rough, and he paid but little attention to his practice, regarding it only as a source from which he might obtain the means of carrying on the scientific investigations to which he was far more attached, and which he had steadily pursued while in the army. To defray the expenses which these entailed he again commenced lecturing on anatomy and surgery; but notwithstanding the talent and extensive knowledge which his lectures evince, they were little appreciated, and he never had a class of more than twenty pupils. Every year, however, added to his reputation, and in 1767 he was elected a fellow of the Royal Society, and in 1768 surgeon to St. George's Hospital. The latter appointment was of the greatest value to him; it increased his income, both by adding to his surgical reputation and by enabling him to take pupils, from whom he received large fees. Among his pupils were Jenner, with whom he remained throughout his life on terms of the closest intimacy, and Sir Everard Home, whose sister he afterwards married. His pupils at St. George's included Abernethy, Astley Cooper, Cline, and James Earle, all of whom acknowledged their indebtedness to his instruction. From the time of his appointment to St. George's, Hunter's life was occupied with a constant and laborious investigation of every branch of natural history and comparative anatomy, physiology, and pathology, to all of which he devoted every hour that he could snatch from the requirements of an increasing surgical practice. In 1773 he suffered from the first attack of angina pectoris, the disease from which he ultimately died. In 1776 he was appointed surgeon-extraordinary to the king, and soon afterwards inspector-general of hospitals, and surgeon-general. For many years after, however, his health seemed pretty good, and he was subject to slighter returns of the disease only when much excited or fatigued; but in 1785 the attacks became more frequent, and he was obliged to leave London. In the following years he became gradually more debilitated, and the slightest fit of anger was sufficient to induce severe spasms. In October, 1793, he was engaged in warm disputes with his colleagues at the hospital, and a remark being made by one of them at a meeting of the governors, on the 16th of the month, which Hunter regarded as an insult, he left the room that he might repress or at least conceal his anger, and had scarcely entered the adjoining apartment when he fell dead in the arms of Dr. Robertson, one of the physicians of the hospital.

John Hunter's Museum consisted, at the time of his death, of upwards of 13,000 preparations, illustrative of human and comparative anatomy, physiology and pathology, and natural history. The principal and most valuable part of the collection, forming the physiological series, consisted

of dissections of the organs of plants and animals, classed according to their different vital functions. He had a beautiful collection of nearly 1000 skeletons; of objects illustrative of natural history, consisting of animals and plants preserved in spirit or stuffed, of which he left over 7000; of upwards of 3000 fossils, and of 218 monsters. The pathological part of the museum contained about 2500 specimens, arranged in three principal departments: the first illustrating the processes of common diseases and the actions of restoration; the second the effects of specific diseases; and the third the effects of various diseases arranged according to their locality in the body. Appended to these was a collection of about 700 calculi and other inorganic concretions. The museum was sold after Hunter's death. The government gave £15,000 for it, and presented it to the College of Surgeons, London, by whom it has been greatly augmented and maintained.

For several years before his death Hunter had been anxious to form a complete catalogue of his collection, and to embody in one large work the results of all his labours and observations. He died when he had completed but a small portion of his design, and left only the materials, with which his successors might have completed a work which would undoubtedly have been the most valuable of its kind ever published. The formation of the catalogue was intrusted to Sir Everard Home, the brother-in-law and only surviving executor of Hunter; but from year to year he deferred his task, and, after supplying only two small portions of his undertaking, he at length announced, that in accordance with a wish which he had heard Mr. Hunter express, he had burned the manuscripts, which he had taken without leave from the College of Surgeons, and among which were the ten volumes of dissections and numerous other original papers. It is generally supposed that Home destroyed Hunter's manuscripts in order to keep secret the source of many of his own papers, published in the *Philosophical Transactions* and elsewhere. The catalogue, however, is now formed in a manner which, although it cannot compensate for the loss of the other, confers the highest credit on those by whom it has been made.

Hunter is, by the common consent of all his successors, the greatest man that ever practised surgery. Considered merely as a surgeon, and with reference only to the direct improvements which he effected in its practice, he stands inferior to few; his improvement of the operation for aneurism was undoubtedly the most brilliant discovery in surgery of his century. He first described the important disease of inflammation of the veins; he first published lucid views on the venereal disease, and by his work on inflammation improved the modes of practice applicable to nine-tenths of the diseases which fall within the province of the surgeon. But it was less by individual discoveries than by the general tone of scientific investigation which he gave to surgical practice that he made it a science, rather than a mechanical art, and induced men of far higher attainments than those who had before practised it to make it their study.

In addition to a large number of original and valuable papers contributed to the *Philosophical Transactions of the Royal Society*, and to the *Transactions* of the Society for the Improvement of Medical and Chirurgical Knowledge, which he helped to found in 1783, he published "A Treatise on the Natural History of the Human Teeth" (Part I., 1771; Part II., 1778); and "Observations on Certain Parts of the Animal Economy," in 1786. His masterpiece, "A Treatise on the Blood, Inflammation, and Gunshot Wounds," was published by his executors in 1794.

As an anatomist and physiologist, his museum alone is sufficient to show that he has had no superior; and while his published works confirm this opinion, and exhibit what he knew, they add to the regret that so much more should have been lost. His surgical works were published under the title of "John Hunter's Surgical Works," with notes by Palmer, to which a life by Drewry Otley is prefixed, in four vols. in 1835.

HUNTER, WILLIAM, was born 23rd May, 1718, at Long Calderwood, near Glasgow. He was entered at the University of Glasgow in 1732, and remained there for five years studying for the church; but while hesitating whether he should pursue that profession he met with Cullen, who was at that time practising as a surgeon and apothecary at Hamilton. An intimate friendship was soon formed between them, the result of which was that Hunter determined to study medicine and to practise in partnership with Cullen. Part of the agreement into which they mutually entered was that each of them should alternately pass a winter at some large medical school, while the other remained in charge of the business in the country. Hunter visited London in 1741, where he resided with Smellie, the celebrated accoucheur, and studied anatomy under Dr. Nicholls, and surgery at St. George's Hospital. Dr. Douglas, to whom he brought a letter of introduction, engaged him soon after his arrival to assist him in completing an anatomical work which he was publishing, and to educate his son. He resided in the family till 1744, when Mr. Sharpe having resigned a lectureship on surgery to a society of naval surgeons, Hunter was elected to fill his place, and at once met with the most marked success. In 1746 he commenced lecturing on anatomy, and in 1747 became a member of the Corporation of Surgeons. But he had always preferred the practice of midwifery to that of surgery, and, several circumstances coinciding to give a favourable prospect of success, he determined in 1749 to confine himself exclusively to the former branch of the profession. In 1750 he took a doctor's degree at Glasgow, in 1764 was appointed physician-extraordinary to Queen Charlotte, and in 1767 became a fellow of the Royal Society. His time was now so completely occupied in the practice of his profession that he was obliged to give up a part of his lectures, and his brother John, Hewson, and Cruickshank were successively his partners. He amassed a large fortune, and died 30th March, 1783, with a reputation inferior only to that of his brother, of whom it was not his least honour that he had been the preceptor and first patron.

William Hunter's principal work was the "Anatomy of the Gravid Uterus," on which he was engaged for nearly thirty years. It contains thirty-four folio plates, most accurately and beautifully engraved from dissections by himself and his brother, illustrative of the most important subjects in obstetrics. He was also the author of numerous essays in the *Philosophical Transactions* and the *Medical Observations.* He founded a medical school in a private house in Windmill Street, with a museum and dissecting rooms attached to it. His valuable museum he bequeathed to Dr. Baillie, who was to hold it for thirty years, and then to transmit it to the University of Glasgow, to which he left £8000 for its maintenance and increase.

HUNTING DOG (CAPE) or **HYÆ'NA DOG** (*Lycaon pictus*), one of the CANIDÆ, is found over the greater part of Central and Southern Africa, being especially abundant around Cape Colony. This daring and ferocious animal is a complete dog in the form of the skull and the characters of the teeth; it has, however, as in the hyænas, only four toes on the anterior feet, and the same on the feet behind. It stands about 2 feet high at the shoulder. In figure it is tall, lightly built, but muscular and well proportioned; the limbs are long, the ears large and erect, the jaws powerful, and the teeth strong. The head resembles that of a hyæna; the muzzle is pointed and of a black colour. Its aspect is wild and fierce, and its disposition treacherous. The fur is close, and of a sandy

yellow colour, irregularly clouded and blotched with black and a little white. The tail is somewhat bushy and of moderate length. The colour is subject to variation. Mr. Burchell, who brought into this country the first specimen, states that it hunts in packs, at night by preference, but frequently in the day. He describes it as swift, fierce, and active, so that only those animals which are gifted with great fleetness can escape from it. It attacks sheep openly, but approaches oxen and horses more cautiously, advancing upon them by stealth, biting off the tails of the oxen, and injuring the horses, especially young colts, so severely that they rarely survive.

HUNT'INGDON, an inland county of England, bounded N. and N.W. by Northamptonshire, S.W. by Bedfordshire, and on all other sides by Cambridgeshire. The population in 1881 was 59,491. The area is 229,575 acres. Huntingdon has no high hills, but there are two or three elevated tracts. The principal rivers are the Ouse and the Nen, with their respective tributaries. The Ouse enters the county from Bedfordshire, near St. Neots, and, flowing past Huntingdon, enters Cambridgeshire at Earith, after a navigable course of 23 miles in the county or on the borders. The Nen has a short course along the northern border before it enters Cambridgeshire. Whittlesea Mere, Ramsey Mere, and Ugg Mere were large pools or lakes which have been drained and reclaimed. Whittlesea Mere was the largest English sheet of water apart from the lake district, 2¼ miles long by 1½ broad, abounding with fish and water-fowl; but in 1851 it was converted into corn-fields and pastures, and occupied with farm buildings. A considerable part of the county is destitute of springs, and is supplied with water from ponds. Formerly it was a deer forest, but at present it is thinly wooded.

The south-eastern part of the county is occupied by the ironsand and gault. The rest of the county, excepting the Fens, and perhaps a narrow strip on the western side, is occupied by the Oxford clay.

The climate is similar to that of the contiguous inland counties—mild and healthy, except in the Fens, where, in addition to the humidity, there is a great want of pure water. The soil in general is a deep loamy clay or loamy gravel, with good meadow land on the Ouse and Nen. The farms are large, and grain, with beans, rape, and clover, are the chief crops. Cheese, butter, and malt are sent to market. The cheese which is known as Stilton cheese is not made at Stilton in Huntingdon, but in the counties of Lincoln and Leicester. Agriculture generally is in an advanced state, especially in the Fens. The sheep are mostly of the Leicester breed. The hogs are Berkshire or Leicestershire, with various crosses.

In 1885 there were 211,000 acres, or more than nine-tenths of the whole area, under cultivation. Corn was grown on 90,000 acres, green crops on 20,000, and 65,000 acres were permanent pasture. Wheat is much more largely grown than any other grain. Huntingdon returns two members to Parliament under the Act of 1885. The county is divided into four hundreds and 107 parishes, and is in the diocese of Ely.

Huntingdon is generally considered to have formed part of the territories of the Iceni, but it must at least have been on the western frontier of that nation. towards the Catieuchlani. Upon the subjugation of Britain by the Romans it was included in the province of Flavia Cæsariensis. Two Roman stations are considered to have been in this county. The Roman Irmin Street crossed the county from S. by E. to N. by W. The Via Devana crossed the county from near Cambridge to Leicester.

In the earlier part of the Saxon period this county was included in the kingdom of the East Angles. It was subsequently annexed to Mercia. In the later period of the Anglo-Saxon dynasty it constituted an earldom, which continued till 1789, when it was supposed to have become extinct; but a claimant having made out a good title in 1819, it was revived, and still exists, the honour being enjoyed by a branch of the Hastings family. In the civil wars of Charles I. Huntingdon was plundered in 1645 by the royalists.

Of the churches, Alwalton, Conington, Hartford, and Leighton Bromswold have some portions of Norman architecture. The tower of Chesterton Church is a good specimen of Early English, with a fine spire. Upton and Wootton churches have also some fine portions of Early English architecture.

HUNTINGDON, the capital of the above county, is 59 miles from London by the Great Northern, or 77 by the Great Eastern Railway. The town is on a gently rising ground on the north bank of the Ouse, and is connected with Godmanchester by three bridges. Very great improvements have been made in the drainage and sewage during the last few years. The principal street extends about a mile north-west from the bridge (dating from the thirteenth century) over the Ouse, and consists for the most part of respectable houses. St. Mary's Church is of Perpendicular character; it was rebuilt in 1620, and was restored in 1876. All Saints has a fine Perpendicular tower, with a good entrance; and another church has been erected by Lady Olivia Sparrow, on the site of the old theatre. There are dissenting chapels, a good town-hall, a corn exchange, county gaol, hospital and lunatic asylum, union, an endowed grammar-school, and other educational establishments. The trade of the town is considerable, principally in malt, wool, and corn; and there are manufactures of patent bricks and tiles for drainage, large breweries, and iron-foundries. The market is well supplied with corn and provisions. The municipal borough is governed by a mayor, four aldermen, and twelve councillors. It was formerly a parliamentary borough returning two members to the House of Commons, but was merged in the county in 1885. The population in 1881 was 6606. The population of the municipal borough is only 4243. Oliver Cromwell was born here in 1599, and was educated at the grammar-school founded by David, king of Scotland, in 1200. Godmanchester, on the opposite side of the river, which seems to have been once an important borough, is now a mere suburb of Huntingdon.

Huntingdon, the Saxon *Huntanton* or *Huntedune*, or *Huntersdune*, probably derived its name from the favourable position it held for the purposes of the chase. The form of some outworks may still be traced, where a castle, built by Edward the Elder in 917, and levelled with the ground by order of Henry II., formerly stood. It is supposed to be also the site of *Duroliponte*, a Roman station.

HUNT'INGDON, HENRY OF, one of the ancient English chroniclers, wrote in the reign of Henry I. and the troubled times of King Stephen. His chronicle is in seven books, reaching to the end of the reign of Henry I., and the very valuable eighth book is one of our best authorities for the writer's own later time, the reign of Stephen. In Henry I. he is more brief, but excellently accurate.

HUNT'INGDON, LADY, one of the three daughters and co-heirs of the second Earl Ferrers, was born 24th August, 1707. She married, in 1728, Theophilus Hastings, earl of Huntingdon, who died in 1746. By personal and family affliction she had been led to take a deep interest in religion, and on her husband's death she resolved to actively aid the Methodist revival then flourishing under the labours of Wesley and Whitefield. The latter she appointed her chaplain, his Calvinistic teaching being such as she admired, and to further the work she devoted her large fortune to the building of chapels in different parts of the country, to which she appointed ministers who were officially designated her chaplains. She also established and endowed a college for the training

of ministers at Trevecca in South Wales, which, after her death, was removed to Cheshunt in Hertfordshire. In 1779 "Lady Huntingdon's Connection" became practically dissenting, but it continued to flourish under her active and autocratic rule until her death, which took place in London, 17th June, 1791. Her chapels, sixty-four in number, were bequeathed, together with the college, to trustees. Most of them have since become in doctrine and practice almost identical with those of the Congregational body.

HUNT'LY, a town of Scotland, in the county of Aberdeen, in the district of Strathbogie, on the S.E. side of the Deveron or Deveran, in the angle formed by the junction of the Bogie, 41 miles N.W. from Aberdeen, and 583¾ from London by the Great North of Scotland Railway. It is a burgh of barony under the marquises of Huntly. The town is surrounded by hills, and consists of streets regularly laid out, the two principal intersecting each other at right angles, with a square or market-place in the centre. It had in 1881 a population of 4388. The parish church, built in 1805, will accommodate 1800 persons, and there are a Free, a United Presbyterian, a Congregational, an Episcopal, and a Roman Catholic church. Stewart's Hall, erected in 1875, containing a public hall and a meeting-room, the public schools, and Scott's Hospital, are the principal buildings. The town has several branch banks, three hotels, post office, and several insurance agencies. There are two good bridges, one an ancient bridge of one arch over the Deveron, the other a bridge of three arches over the Bogie. Many of the inhabitants find employment in tile, brick, and plough making. There is also a considerable trade in grain and dairy produce. Huntly was formerly celebrated for its manufacture of linen. Near the town are the ruins of Huntly Castle, once the seat of the Gordon family.

HURA. See SAND-BOX TREE.

HURDLES. The common hurdle is too well known to require description. In military exploits hurdles are straight flat rectangles of strong wicker-work, about 6 feet long and 3 feet high, used for fencing barriers or in the construction of hurdle batteries. In the latter three of them are fastened at their ends in the form of a triangle, and the central space speedily filled up with earth. A number of these triangles are made to any ground-plan, behind which a body of soldiers can entrench themselves in a very short time.

HURDWAR'. See HARDWAR.

HURDY-GURDY, a mechanical violin, wherein the friction of the bow is replaced by that of a rosined wheel against strings of catgut and of wire, the wheel being set transversely to the instrument and turned by the right hand of the performer. The stopping of the strings is done by the left hand, as by performers on other stringed instruments; but instead of the fingers pressing the strings against the finger-board, certain levers perform this office, which levers are operated on by keys, forming altogether a keyboard resembling that of a pianoforte, with black and white keys. The instrument is suspended from the neck. While the right hand turns the wheel of the hurdy-gurdy, scraping across the strings, the left hand plays upon this keyboard, and the melody is thus produced by artificial means exactly corresponding to the natural operations of the violinist. To support the melody one or more drone strings, not altering in pitch, and constantly sounded by the wheel, are added to the melody-strings; and these answer, therefore, respectively to the drones and the chanter of the bagpipe. Other drones there are which can be brought into play or not by a simple mechanism. The instrument is made in various forms, but by far the most usual shape at the present time is that of a lute.

The hurdy-gurdy, like all imperfect instruments, tends to die out; it is now seldom heard even in the streets, though it is not many years since it was intolerably frequent. But it had a very great vogue in its day, and that, like the bagpipe, in all lands alike. In France it developed out of the old viol, and was called *vielle;* in Italy it was called *rota*, from the wheel which is its characteristic feature, or the *lira*, because of its development from the lyre (lute); and so also in Germany it was and is the *leier*. (The rote of Chaucer was a *crwth*, not a hurdy-gurdy.) Our English name is simply an attempt to imitate the whirr of the rattling drone-strings. Hurdy-gurdies are usually now a little over 2 feet long, but in mediæval times were often much longer. Not unfrequently, as we see in old illuminated MSS., a menial turned the wheel, fulfilling the like function to an organ-blower, and leaving both hands of the performer free; or large instruments were made, on which two performers played at once. These were called Organistrums.

HU'RON, one of the five great lakes of North America. It receives the waters of Lakes Superior and Michigan, by the St. Mary and Mackinaw straits, and discharges by the river St. Clair into Lake Erie. Its greatest length is 240 miles; greatest breadth, 220 miles; area, 20,400 square miles; and depth generally, about 1000 feet, in some places 1800, or 1200 feet below the level of the Atlantic, above which its surface is 600 feet. The portions cut off north and east by the peninsula called Cabot's Head, and by the Manitoulin Isles, are called Manitou (Great Spirit) Bay and Manitoulin Lake or Georgian Bay. It contains about 3000 considerable islands. Dr. Drake found the water at 200 feet depth of the same temperature (56° Fahr.) as at the surface. Of its many islands, Great Manitoulin is the only one that is inhabited. Its waters are very limpid. Its shores present clay cliffs, wooded slopes, and terraces, indicating former higher levels of its waters; are deeply indented, and furnish several good natural harbours. Sarnia in Lambton county, Ontario province, and Port Huron in Michigan state, United States, are on opposite sides of the outlet. The other principal towns on the shores are Goderich in Huron county, and Collingwood in Nottawasaga Bay. In Huron county, on the east side of the south reach of the lake, salt water exists at a considerable depth, and being pumped up to the surface and evaporated under artificial heat, yields a large percentage of pure salt. A similar bed is formed in the United States territory opposite; and it is considered that both are parts of a vast subterranean sheet of salt water, extending quite across, under the bottom of the lake, from Goderich to Port Salinac, a distance of 40 miles.

HUR'RICANE. In the strict sense of the word a hurricane is a violently rotating wind which often sweeps over the Western Atlantic. In China a similar wind is called a typhoon, and in India a cyclone. Other winds of somewhat the same kind, but not so destructive, are called whirlwind, tempest, water-spout, land-spout, sand pillar, tornado, white squall, pampero, &c. Hurricanes occur most frequently and with the greatest violence in tropical climates, chiefly because, in consequence of the very great heat which there prevails, the rarefaction of the air, and also the condensation of the vapour it contains into rain-drops, take place more suddenly and completely than in more temperate regions. Scientific men to this day are not quite unanimous as to the source and origin of these winds; but after many years of patient and extended investigation they have obtained such information as to their form, course, and velocity, that they are enabled to issue directions to mariners by which their former devastating effects may to a great extent be prevented, and in some instances the storm itself rendered subservient to the purposes of navigation.

It was for a long time supposed that hurricanes were powerful winds which swept in a straight course along a certain track, which observation had shown to be nearly

always used by them; and it was not till Mr. Redfield of New York and Colonel Sir W. Reid of the Royal Engineers devoted themselves to the study of the subject, and learned those facts respecting the hurricane for which all who traverse the ocean must ever owe them a debt of deep gratitude, that any practical information on the matter could be issued for the benefit of sailors. It is now ascertained beyond any doubt that in hurricanes, tornadoes, typhoons, and other tempests of a similar character, the wind has a violent movement in a circular or spiral direction, apparently about a mathematical axis—the latter having at the same time a progressive motion on the surface of the land or sea. The diameter of the circle within which the gyration of the wind takes place varies from a few hundred yards to several hundred miles, but the circular motion is, of course, limited to the circumference of the hurricane itself. The progressive motion is no greater than that of the general wind prevailing at the time, which, under circumstances so violent as to admit of the presence of hurricanes, may be somewhat faster than the usual rate. The circular motion is generally upwards of 100 miles an hour, and is always in one unvarying direction. What formerly appeared to be the shifting of the wind is in reality only the progress of the storm, and shows that the ship, island, or whatever it may be, has come within the influence of another quadrant of the hurricane; because it will be evident that the velocity of the wind in a revolving storm must be the greatest and least respectively on opposite sides of the axis of rotation, in a diameter which is perpendicular to the path of that axis, for on one side the direction of the revolving current harmonizes with that of the progressive motion of the storm, and on the other it is contrary to it. The direction in which the storm always revolves is from right to left in the northern hemisphere, and from left to right in the southern—in each case contrary to the apparent course of the sun. This being so, it is evident that in a hurricane in the northern hemisphere the prevailing wind at each of the four great points of the compass will be as follows:—At the northern margin, an easterly wind; at the western margin, a northerly wind; at the southern margin, a westerly wind; and at the eastern margin, a southerly wind. The intervening points, of course, are affected by winds modified of these, and the whole arrangement reversed exactly describes a hurricane in the southern hemisphere. With this knowledge the captain of a vessel, by simply observing the direction of a cyclone wind, can easily ascertain his position in the hurricane and how its centre bears from him, and he then only requires to know the way in which the wind will haul to enable him to make such preparations as may insure the safety of the ship, or even to use the hurricane for the purposes of his voyage.

An acute observer can easily detect the indications of an approaching hurricane. The enormous volumes of vapour which the whirling air within the cyclone, and the external air rushing into it from without, collect and keep together, appear like a dense dark wall resting on the horizon in the direction from which the hurricane is approaching. The sky also has a lurid and threatening aspect, the atmosphere becomes oppressively hot, and the clouds are tinted with a deep red or dark olive colour. The sun, moon, and stars shine with a pale and sickly light, and as the hurricane approaches the wind at first moans fitfully and then roars. But as most of these warnings do not allow time for advantage to be taken of them, it is always best to rely upon the barometer, which is quite as certain, and always gives the earliest intimation of the approaching tempest. If the mercury suddenly shifts from high to low, or *vice versâ*, and is followed by persistently high and unusual readings, a storm may be expected and measures taken accordingly. By due attention to the barometer the ship's position in the hurricane may also be determined, and much danger avoided.

Although so much is now known respecting the laws of storms, we have yet to learn their precise causes, the intervals between their recurrence, and other matters connected with them, before we can consider our knowledge on the subject thoroughly satisfactory.

HUSBAND AND WIFE, LAWS RELATING TO. Under this title we purpose dealing with the effects of marriage on the legal position of the parties, as regards their personal rights and their property. The law with regard to the dissolution of marriage has already been considered under DIVORCE, and the modes of contracting marriage will be considered under MARRIAGE.

It was from a very early period a principle of the common law of England that when marriage took place the personalty of the wife became merged in that of the husband, hence the maxim that "husband and wife constitute one person in the eye of the law." By this principle, while the position of the husband was very slightly affected, and he remained in almost the same condition of freedom as before marriage so far as business and property were concerned, very material alterations were made in the position of the wife. The husband retained, as he still does, the power of entering into contracts, could sue and be sued, could deal as he pleased with his property during life, and bequeath it to whom he pleased by means of a will, without regard to his wife. On the other hand the wife ceased to be able to enter into contracts in her own name; her personal property passed absolutely to the husband; all debts due to her before marriage became due to him, provided he chose to reduce them into possession; and, speaking generally, she could neither possess any subsequently acquired property nor enjoy her own earnings separately from her husband. In consequence of this principle of the law the husband became, however, liable for all debts contracted previously to the marriage by his wife, and a wife could not be convicted of stealing her husband's goods, even if she absconded with the property. As husband and wife were considered as one, neither could be allowed to give evidence against each other in any trial, civil or criminal, and where any crime short of treason or murder was committed by husband and wife jointly, or by the wife in the presence of her husband, the wife was presumed to have acted under the compulsion of her husband, and was acquitted as a matter of course.

In the process of time, however, many alterations were made in the laws relating to husband and wife. With respect to the property of the latter the courts of equity gradually removed some of the most unjust features of the common law, and secured to women of the wealthier classes a fair measure of protection for their rights. Still more important reforms have been effected during recent years, and by the important statutes known as the Married Women's Property Acts of 1870 and 1874 a large amount of protection was extended to the women of all classes. Valuable and useful as these measures proved to be, there were certain defects and omissions disclosed in the working of them which led to their repeal in 1882 by the passing of the Married Women's Property Act of that year, 45 & 46 Vict. c. 75, which now regulates the law upon the subject. By this Act the property distinction between a married and an unmarried woman was almost completely abolished, and a married woman was made capable of acquiring and holding any real or personal property as her separate estate, without the intervention of any trustee, and of disposing thereof by will or otherwise.

This Act came into operation on the 1st January, 1883, and consequently every woman married since that date is entitled to hold as her separate property, and dispose of by will or otherwise, all real and personal property belonging to her at the time of marriage, or acquired by or devolving upon her after marriage. This includes all wages or earnings acquired in any trade or employment carried

on separately from her husband. In the case of women married before 1st January, 1883, they are entitled to all earnings acquired separately after that date, and to hold and dispose of as their separate property all real or personal estate that may devolve upon them after that period. It is further provided that any money deposited in a bank, invested in a building or benefit society, or in stocks, shares, or debentures in the sole name of a married woman shall, unless the contrary be shown, be taken to be her separate property. But this does not apply to any such investment made with the money of the husband and without his consent. A married woman is now entitled in her own name, against all persons, including her husband, to the same remedies, civil and criminal, for the protection and security of her own separate property, as if such property belonged to her as an unmarried woman. She is also made capable of entering into any contract to the extent of her separate property; and of suing and being sued, either in contract or in cases of injury or wrong, in all respects as if she were unmarried. A married woman carrying on a business separately from her husband is subject to the bankruptcy laws and may now be made a bankrupt. If a married woman is appointed executrix or administratrix of the estate of any deceased person, or is appointed a trustee, she may in such capacity sue and be sued, and may make transfer of any money, stocks, &c., without her husband, as if she were an unmarried woman. In such cases the husband is not liable for any breach of trust or neglect committed by his wife unless he has acted or intermeddled with the business. A wife may effect a policy of assurance upon her own life, or the life of her husband for her separate use, and she may also insure her own life for the benefit of her husband, or of her children, or any of them. A husband in like manner may insure his life for the sole benefit of his wife and children, or any of them, and by so doing a trust is created in either case in favour of the objects named, and the policy is not subject to his other debts. A woman after marriage continues to be liable in respect and to the extent of her separate property for all debts incurred before that event; but a husband is not now liable for debts contracted previous to marriage by his wife, except to the extent of all the property which he shall have become entitled to through her. A wife having separate property may be compelled to maintain her husband should he become destitute and chargeable to the parish, in the same way that a husband may be compelled to support his wife. A married woman having property is also liable to maintain her children and grandchildren if her husband is unable to do so, but the possession of property by the wife does not free the husband from any legal responsibility in this respect.

A married woman cannot make any contract binding on her husband unless he gives her authority as his agent to do so, nor can she pledge his credit for anything beyond the necessaries of life without his permission. If, therefore, a wife orders goods or clothes that are extravagant and unnecessary without the consent of her husband, he can repudiate the contract and return them, but he must not knowingly keep the goods and then refuse payment. If a wife has regular dealings with a tradesman, and the debts incurred are paid without demur by the husband, such tradesman has a right to assume, in the absence of any notice to the contrary, that the wife is entitled to pledge her husband's credit. It was decided, however, in 1880, in an important case which was carried to the House of Lords, that if a husband, while supplying his wife with all necessaries suitable to her position in life, has forbidden her to pledge his credit (without making the same public in any way), such husband is not liable for a debt incurred by his wife with a tradesman with whom she had not previously dealt, even though the articles supplied were not extravagant or unsuitable. Where a husband unjustifiably refuses to maintain his wife and family he becomes liable for all contracts entered into by her for the supply of the necessaries of life. If a wife through the wilful neglect of her husband becomes chargeable to the parish, the parish authorities can seize his goods, if he has any, and sell them for her support; and if he is able to work, but will not, he is liable to a month's imprisonment for being idle and disorderly. A husband deserting his wife and leaving her chargeable to the parish renders himself liable to three months imprisonment as a rogue and a vagabond. A wife deserted by her husband, who maintains herself by her labour, is now protected in the enjoyment of the fruits of her labour, and by application to a judge of the Divorce Court, police magistrate, or the justices of the peace in petty sessions assembled, may secure a protection order, which will secure her against molestation from her husband or his creditors. By the Act 41 Vict. c. 19, if a husband be convicted of an aggravated assault upon his wife, the court or magistrate before whom he is convicted has the power to grant an order to the wife which shall have the effect of a judicial separation, and may further provide for the payment of a weekly sum by the husband for the support of the wife, and give to her the custody of the children under ten years of age. While, however, at the present time the law awards a certain measure of protection to a wife against the conduct of an idle or disorderly husband, it provides no remedy for the misconduct of a wife short of that which would entitle the husband to a judicial separation or divorce. A wife may be a habitual drunkard, may neglect her family and all her household duties, may quarrel with her husband and with others, so as to injure his business and bring him to ruin, and the law affords him no remedy whatever. It has been suggested that the provisions of the Matrimonial Causes Act of 1878 might be extended with considerable advantage, and that a magistrate's protection order might be granted for the protection of either husband or wife, and that habitual drunkenness and the neglect of conjugal duties should be a sufficient ground for a judicial separation. The matter is one that certainly needs consideration, for it is beyond question that the neglect of the law to provide a remedy for the cases indicated is not only a cause of much misery, but leads very frequently to lawless proceedings on the part of the injured parties, sometimes of a very serious character.

By the Act of 1882 the old rule which prevented husband and wife from giving evidence either for or against each other in criminal cases has been somewhat modified. Carrying out the principle that the wife is to be independent in her dealings with her property, the twelfth section of the Act provides that "every woman, whether married before or after this Act, shall have in her own name, against all persons whosoever, including her husband, the same civil remedies, and also (subject as regards her husband to the proviso hereinafter contained) the same remedies and redress, by way of *criminal* proceedings, for the protection and security of her own separate property, as if such property belonged to her as a *femme sole*." The exception referred to prevents criminal proceedings being taken by any wife against her husband "while they are living together" as to any property claimed by her. If a husband, however, wrongfully takes property from his wife when leaving and deserting, or about to leave and desert her, a criminal proceeding will lie, although they were not living apart when the injury was committed. By the sixteenth section it is further provided that a wife doing any act with respect to any property of her husband, which if done by the husband with respect to property of the wife would make the husband liable to criminal proceedings by the wife under this Act, shall in like manner be liable to criminal proceedings by her husband.

In civil cases husbands and wives may be witnesses for or against other parties, and by the Act 40 & 41 Vict. c. 14,

on the trial of any indictment for a nuisance or other proceedings to enforce a civil right, the defendant and husband or wife of such defendant are competent witnesses.

Where a wife dies without a will the whole of her personal estate becomes the property of her husband; but when a husband dies intestate the wife is only entitled to one-third of the personal property if there is a child or children, and one-half if there are no children.

The old law of Scotland applicable to the status and relations of married persons *inter se*, and with respect to the public, was in the main much the same as the old law of England. The wife's *persona* was supposed to be merged in that of her husband; and from this fiction it followed that she could not enter into contracts or become liable for obligations on her own account. She might, however, be a trustee, or executrix, or agent with her husband's consent, but not a tutor or curator. The wife's proper curator was her husband. In actions by or against her the husband had to be called for his interest. The goods of the spouses were held to be in common, and of these the management was held to be in the husband in virtue of his *jus mariti*. The wife's heritage remained her own property, but the rents as they accrued became the property of the husband. Moreover, the husband's right of administration extended over the whole of the wife's real property—he acting as her guardian. At an early period it was held that the husband could not, by contract of marriage or otherwise, be deprived of these rights; but this doctrine was afterwards departed from.

These the principles of the old common law have been materially modified in recent times by statutes passed on the same lines with the English Acts above referred to. The following are the Scotch Acts:—Conjugal Rights Act, 1861 (24 & 25 Vict. c. 86), amended by 37 & 38 Vict. c. 31; the Married Women's Property Act, 1877 (40 & 41 Vict. c. 29); the Married Women's Policies of Insurance Act, 1880 (43 & 44 Vict. c. 26); the Married Women's Property Act, 1881 (44 & 45 Vict. c. 21). These Acts, coupled with the decided cases that have followed on them, have tended greatly to assimilate the laws of the two countries in all that relates to the rights of married persons during their marriage; leaving, however, the laws applicable to the contracting of marriage and its dissolution still very much at variance.

When marriage was dissolved by death within year and day, and without the birth of a living child, the old law was that the property of the spouses returned as nearly as possible to the state in which it would have been had no marriage been contracted. This, however, might have been altered by marriage contract; and by 18 Vict. c. 23, sec. 7, it is now declared that a marriage dissolved by death within year and day shall have the same legal effects as if it had subsisted for a longer period. When dissolution takes place by the death of the wife, the husband is entitled to the life-rent of her heritage, in virtue of what is called the *courtesy of Scotland*; but the goods in communion formerly fell to be divided as follows:—If there was no child the surviving husband retained one-half, and the other half went to the wife's next of kin, or as directed by her will. If there were children of the husband by that or a former marriage, the wife's share was one-third only. But the children could not claim their third, *i.e.* their *legitim*, till their father's death. This has now been considerably changed by the Intestate Succession Act of 1855, sec. 6 of which provides that when a wife predeceases her husband, her representatives, whether legal or testamentary, shall have no share in the goods in communion; and by the Married Women's Property Act, 1881, sec. 6, which provides that the husband shall have the same interest in his deceased wife's movable estate as a widow would have in that of her husband, and that the children on the death of their mother shall have the same claim to *legitim* out of her estate as they have out of the movable estate of their deceased father. When the marriage is dissolved by the death of the husband, the widow is entitled to the life-rent of one-third of the realty in which he died feudally invested. This is termed her *terce*. She is also entitled to one-half of the goods in communion when there are no children, and to one-third when there are. This is called her *jus relictæ*. The children are also entitled to their *legitim*, that is, the third of their father's free movable property. There remains the *dead's part*, of which the husband can dispose absolutely. If he is survived by neither wife nor children, this includes his whole movable estate; and if he is survived by his wife and no children, or by the children and no wife, it means one-half; if by both wife and children, it is restricted to one-third. Such, generally stated, are the legal rules on dissolution of the marriage by death. They may all, however, be altered, within certain limits, by marriage contract, or subsequent arrangements, and the courts will give effect to such alterations where they do not tend to render the rights of parties simply nugatory. When the marriage is dissolved by divorce, the general rule is that the offending party loses all the provisions, whether legal or conventional, which would have accrued to such party in the case of dissolution by death. The legal or conventional rights of the children are not, however, affected. For a full exposition of the law of Scotland in relation to the subject of this article, reference must be made to the exhaustive work by Lord Fraser on husband and wife.

HUS'BANDRY. See AGRICULTURE.

HUS'KISSON, WILLIAM, one of the earliest official inaugurators of a liberal commercial policy in this country, was the son of a gentleman farmer of good family and estate, and was born 11th March, 1770, at Birch Moreton Court, Worcestershire.

In 1783, when in his fourteenth year, William Huskisson was sent to Paris, and became an enthusiast in the cause of the French Revolution. He was present at the taking of the Bastile in 1789, and became a member of one of the French clubs, from which, however, he soon withdrew. In the following year (1790) he became private secretary to Lord Gower (afterwards the Marquis of Stafford), who was then the English ambassador. After the events of the 10th August, 1792, the English ambassador was recalled, and Mr. Huskisson returned with him to England. Early in 1795 he was appointed under-secretary of state in the department of war and colonies under Mr. Dundas. Towards the end of 1796 he was returned to Parliament as member for Morpeth. On the retirement of Pitt he resigned his official situation. He was unsuccessful in procuring a seat at the general election in 1802, and did not appear again in Parliament until 1804, when he sat for Liskeard. He was secretary of the Treasury under the administration formed by Pitt in 1804, and after the death of that minister was an active member of the Opposition. At the general election in 1806 he was re-elected for Liskeard, and after the dissolution in 1807 he sat for Harwich, and continued to do so until 1812. From this period until 1823 he represented Chichester, in which neighbourhood he had, in 1801, purchased a small estate. From 1823 until his death he represented Liverpool.

On the retirement of the Whigs from office in 1807 Huskisson resumed his former post as secretary of the Treasury. He resigned his office in 1809 along with Canning. In August, 1814, he was appointed chief commissioner of woods and forests. In 1823 he was made president of the Board of Trade, when he relaxed the navigation laws, the reciprocity acts, &c., under which, by an Order in Council, foreign ships in matters of importation and exportation were placed on an equality with British ships. Then followed a sweeping reduction of protective duties on foreign merchandise, which in the case of silk manufactures brought much odium on the proposer; but

the expositions of his policy—clear and convincing—soon brought him converts to the new doctrine. After the death of Canning, in August 1827, Huskisson held the office of secretary for the colonies in Lord Goderich's cabinet; and he retained his post when this cabinet was broken up and the Duke of Wellington became the head of a new ministry, but resigned in May, 1829, and his resignation was followed by that of Lord Palmerston, Grant, and several others who had belonged to what was called "Canning's party."

He attended the opening of the Liverpool and Manchester Railway, 15th September, 1830, at which ceremony he received fatal injuries from the engine and died the same evening. A collection of his speeches was published in 1831.

HUSS, JOHN, or more correctly *Hus*, reformer and martyr, was born at Hussinecz, a village of Bohemia, in 1369 or 1370. His parents appear to have been well-to-do peasants, and he studied at the University of Prague, becoming bachelor of arts in 1393, bachelor of theology in 1394, and master of arts in 1396. He began to lecture in 1398, and in 1401 was made dean of the faculty of philosophy. The same year he began to preach in the vernacular Czech at the Bethlehem Chapel, Prague, and his sermons soon excited the greatest interest among all classes of society. He had become profoundly impressed with the necessity for a reformation of the church, through an earnest study of the writings of Wyclif, and his denunciations of the sins of the clergy soon awakened the enmity of the ecclesiastical authorities. In 1403, when the teachings of Wyclif were condemned by the university, Huss zealously defended them; but it was not until 1408 that he came under the censure of the archbishop, who deprived him of his office as preacher and forbade him to exercise priestly functions in the diocese. In 1409 the king, Wenceslaus, who had been his defender, greatly furthered his cause by a change in the laws of the university, which led to the retirement of some 5000 foreign students and professors, and left the Bohemian party in possession. In 1409 Huss was elected rector of the university, but the following year the archbishop, armed with authority from the pope, demanded that all the writings of Wyclif should be destroyed, and excommunicated Huss and his friends—steps which awakened great popular excitement, in some of the manifestations of which the clergy were seriously threatened and the king had to interfere. The reformer appealed against his sentence to the pope, John XXIII., but his appeal was dismissed, and he was summoned to Bologna to meet the charges of heresy which had been preferred against him. His friends, alarmed for his safety, prevailed upon the king to forbid the journey and to demand that the case should be heard by papal commissioners in Bohemia. This was refused, and Huss was a second time excommunicated, but the king still standing his friend a compromise was effected in 1411, and he was permitted to make a public profession of his faith, which was sustained as orthodox. The following year the publication of a bull of the pope proclaiming a crusade against Ladislaus of Naples, an enemy of Pope John's from earlier days, brought Huss again into conflict with the papal authorities for having publicly and fiercely denounced it from his pulpit. The people carried the offending document in procession through the streets and burnt it ignominiously. In consequence of this he was once more excommunicated, and the city of Prague for sheltering him was laid under an interdict, so that he had to retire for protection to the castles of some of his friends among the nobility, where he employed his leisure in the composition of several writings, the chief of which was his treatise "De Ecclesia." In the year 1414 the meeting of a general council at Constance was arranged by the same Pope John and the Emperor Sigismund, and Huss was summoned to attend. The emperor promised that he should have a hearing in the council, and gave him a "safe-conduct" to guarantee his return to Bohemia in the event of the council deciding against him. Huss accepted the conditions, and on the 3rd November he arrived at Constance, and the same month, despite the emperor's safe-conduct, he was arrested and thrown into prison before any charge had been formulated against him. He was kept in custody until 5th June, 1415, when he was brought before the council and charged with heresy, and when he attempted to speak in his defence his voice was drowned by the outcries of the assembled ecclesiastics. He was again brought up on 7th and 8th June, and finally ordered to recant under pain of death. Remaining firm against the zealous efforts that were made to shake his determination, he was on the 6th of July, his birthday, pronounced guilty of heresy at the Cathedral of Constance, publicly degraded, and handed over to the secular power for execution. The same day he was burned at the stake, enduring his fate with unshaken constancy, and praying in the words of the *kyrie eleison* until the smoke stifled his voice. His ashes, and even the ground upon which they lay, were gathered up and thrown into the Rhine.

In person Huss was tall and thin, pale in countenance, and generally dressed in "mean attire." His character was pure and unblemished, and his bitterest enemies could bring no charge against his conduct. He possessed but little originality as a thinker or writer, and as Dr. Johann Loserth, professor of history at the University of Czernowitz, has shown in his "Wiclif und Hus" (trans., London, 1884), many of his works are largely made up of extracts taken literally from the writings of Wyclif. He did not, however, slavishly follow the latter reformer, for he differs from him on many important points, especially in respect to the doctrine of transubstantiation. The peculiar glory of Huss is that he possessed a noble steadfast character, and in his devotion to what he felt to be the cause of truth and religion, and in his martyr's death, he exercised a grand moral influence, which has been of immense value to the church and to the world.

The Latin works of Huss were printed at Nuremberg in 1558, and were reprinted with many additions in 1715. His Bohemian works, edited by K. J. Erben, were published at Prague in 1866.

HUSSAR', a light cavalry trooper, dressed in loose jacket and fur cap, and usually armed with a sabre and pistol. The term was originally applied to the Hungarian horse-soldiers. Every twenty houses or families were ordered by Mathias I. to furnish to his army one horseman; hence from *husz*, twenty, and *ar*, pay, came the word *hussar*. There are now hussars in every well-organized army.

HUS'TINGS (Old Eng. *husting*), formerly the principal court of the city of London, in which the lord mayor and aldermen presided. According to Fleta other towns, as York, Winchester, &c., had courts of the same name. The word means a council or assembly, and is common to all the Scandinavian and Teutonic tongues. The name hustings is now given to a temporary platform used for orators to address an open-air gathering from. It was from a hustings that candidates for Parliament were formerly proposed or nominated for election.

HUTCH'ESON, FRANCIS, may be regarded as the founder of the Scottish school of metaphysics; Carmichael, who preceded him in the chair of moral philosophy at Glasgow, having done but little to render it famous. Hutcheson was, however, not a Scotchman, but an Irishman. He was born at or near Drumalig, in County Down, in 1694, was educated at the University of Glasgow, became a licentiate of divinity, and was at first a teacher in Dublin. At Carmichael's death he was elected professor of moral philosophy at Glasgow (1729). Up to this time he had published his works anonymously, and even thus they had made some stir. He now avowed their authorship;

but his writings after this were neither so numerous nor so original as those published while he was at Dublin. The laborious duties of his office, in which he was diligent to an exemplary degree, prevented this. His character was such that he was universally beloved. He was so unaffectedly benevolent in himself that no doubt this influenced many of his hearers and readers favourably towards his professedly benevolent theory of morals. By such illogical considerations are men oftentimes swayed. Hutcheson died in 1746, full of respect and honour.

His chief works are "An Inquiry into the Original of our Ideas of Beauty, Order, Harmony, and Design" (London, 1725); another inquiry concerning "Moral Good and Evil" (same year and place); an "Essay on the Passions and Affections" (London, 1728); and "Illustrations of the Moral Sense" (same date and place); a "Synopsis of Metaphysics, &c." (1742); and a "System of Moral Philosophy," with a life, published by his son in two volumes in 1755, shortly after the death of the philosopher.

Hutcheson's fame, however, rests upon the four Dublin treatises, and these are most fascinating and remarkable speculative works. He boldly strikes for the complete existence of a *moral sense* as perfect and as definite as the physical senses. We distinguish right from wrong by virtue of our moral sense (conscience), just as we tell light from dark, sweet from sour, treble from bass, or hot from cold. Moral goodness he defined as consisting in the right relation of our various propensities to each other, and this relation was at once and without experience perceived by the mind through the conscience.

The criterion of right and wrong, however, he does not consider to be our own judgment; but with curious inconsistency admits that the test of the rightness of an action is its influence upon the general weal. The more beneficent an action, the more virtuous it is.

HUTTEN, ULRICH VON, the famous champion of humanism and religious liberty in Germany, was born of an old knightly family at Steckelberg, in Hesse, on the 21st of April, 1488. He was placed by his father in the monastery of Fulda in 1498, but fled from it in 1504; and struggling with many privations, he studied at Cologne, Erfurt, Frankfurt-on-the-Oder, Greifswald, and in 1511 and 1512 at Pavia in Italy. In 1514 he gained the patronage of the Elector of Mainz, and the following year he wrote a series of satires directed against the Duke of Würtemberg, who had murdered John of Hutten, his brother. In 1517 he was made poet laureate by the Emperor Maximilian, who also conferred upon him the honour of knighthood. In 1519 he assisted in a private war against the Duke of Würtemberg, and made the acquaintance of Franz von Sickingen, the champion of the knightly order, who afterwards gave him protection, and for whose cause Hutten laboured with characteristic earnestness. After the defeat and fall of Sickingen, Hutten fled to Basel, where, tormented by poverty and disease, the latter largely owing to his reckless habits of life, he sought the aid of Erasmus. The latter refused to see him, and Hutten straightway attacked him in a series of pamphlets, to which Erasmus replied with great bitterness, and further showed his enmity by driving Hutten out of the district. He fled to Zurich, where he was aided by Zwingle; and on the island of Ufnan, on the Zurich Lake, he died 29th August, 1523, at the age of thirty-five, worn out with disease and possessed of nothing save his clothes, his pen, and a bundle of letters.

Hutten, with all his faults, was an unselfish patriot and an earnest defender of what he felt to be the cause of truth and right. He was more devoted to poetry and the classics than to the reformed theology; but he judged rightly that an ecclesiastical revolution was necessary before the open and successful cultivation of humanism or classical and general literature could become possible.

He was the author of an immense number of letters, pamphlets, poems, and satires; and his works, of which a collected edition was published at Berlin (1821–27), extend to six volumes. Hutten had a principal share in the composition of the famous "Epistolæ Obscurorum Virorum," a satire of unequalled keenness, cleverness, and bitterness on monastic ignorance, written in defence of Reuchlin against the Dominicans.

See "Ulrich Von Hutten," by Dr. David Friedrich Strauss (Leipzig, 1858; Eng. trans., 1874).

HUY, a town of Belgium, in the province of, and 17 miles S.W. from Liège, the capital of an arrondissement, and romantically situated on the river Meuse. The name is pronounced *We.* The town is fortified, has a line of railway, a college, ironworks, breweries, and a citadel, which is now about to be demolished. There are also leather, tile, paper, tinplate, zinc, brandy, glue, and other factories, and a brisk trade in corn. The Church of Notre Dame is a fine structure in the most perfect Gothic style, was begun in 1311, but renewed after a fire in the sixteenth century. The number of inhabitants is 11,000. Peter the Hermit was interred in the abbey of Neufmoustier, which he founded at Huy on his return from the first Crusade.

HUY'GHENS, CHRISTIAN, a celebrated astronomer, mathematician, and physicist, was born at the Hague, 14th April, 1629. He studied at Leyden and Breda, and in 1651 he became known to the world of science by the publication of a treatise, "Exetasis Quadraturæ Circuli," in reply to Gregory St. Vincent's "Opus Geometricum" on that subject. The same year he issued his "Theoremata de Quadratura Hyperboles," &c., and three years later, in his work "De Circuli Magnitudine Inventa," he made the closest approximation hitherto attained of the ratio of the circumference to the diameter of the circle. He next devoted himself to the improvement of the telescope, and in 1655, by means of an instrument of his own construction, he discovered a new satellite of Saturn and detected the true character of the ring of that planet. The following year he invented the pendulum clock, and in 1658 published a description of the mechanism necessary. In 1659 the account of his discoveries in relation to the planet Saturn was published in his "Systema Saturnium," and at the end of the book he described his important invention of the micrometer, an instrument of the greatest importance in astronomical research. In 1663, on his second visit to England, he was made a member of the Royal Society, to which in 1669 he communicated a statement of the laws governing the collision of elastic bodies, which he had independently discovered about the same time as Wallis and Wren, but the latter had anticipated him in the publication of the results of their researches. In 1666 he received a tempting offer from Colbert to settle in France, which he accepted, and remained in that country until 1681. His great work, the "Horologium Oscillatorium," appeared in 1673. In this he describes the well-known but now disused apparatus by which the geometrically isochronous or cycloidal pendulum was obtained. But this is the least part of this celebrated work, which contains four distinct discoveries of first-rate importance. The first is that of the cycloid, being the curve all whose arcs measured from the lowest point are synchronous. The second is the invention of the involution and evolution of curves, in which the proposition is established that the cycloid is its own evolute. The third is the method of finding the centre of oscillation, being the first successful solution of a dynamical problem in which connected material points are supposed to act on one another. The fourth is the announcement (without demonstration) of those relations between the centrifugal force and velocity of a body revolving in a circle, which were afterwards proved by Newton in the "Principia."

In 1681, being alarmed at the measures which were

directed against the Huguenots, he retired to Holland, where he spent the remainder of his life. During the next six years he constructed a series of lenses of enormous focal distance, which were mounted on high poles and connected by cords with the eye-piece, and he also constructed the beautiful achromatic eye-piece still known by his name. His latest great discoveries were in connection with the laws of optics, in which he maintained the undulatory theory in opposition to that of emanation, which was adopted by Newton. By this theory he gave a sufficient explanation of the phenomena of reflection and refraction, and also of that of double refraction, which Newton's theory failed to account for. The undulatory theory is now universally adopted, and Huyghens must be considered as the founder of it, for though Hooke had previously advanced the notion, yet he made no application of it to the explanation of phenomena. Huyghens died at the Hague, 8th June, 1695.

Two quarto volumes of his works were published at Leyden in 1724, and two additional volumes at Amsterdam in 1728. His correspondence was published at the Hague in 1833.

HUY'SUM, JAN VAN, was born at Amsterdam in 1682. The father, a picture-dealer and painter, was the instructor of his son, who soon became celebrated as a flower and fruit painter. His flowers are even more beautiful and true to nature than his fruits. He is equally successful in the accessories. He was the first who painted flowers on a light ground. His colours still retain their lustre, and his pictures are still held in the highest estimation. He died in England in 1749. He had three brothers, all painters; one of them, Jacob, came to England, and was chiefly occupied in copying the pictures of his brother Jan, which copies are doubtless reputed to be by the more celebrated brother.

HY'ACINTH. Few spring flowers are more worthy of cultivation than the hyacinth, whether we regard its varied shades of rich colour or the sweetness of its perfume. The soil and climate of Holland seem to be peculiarly adapted to this plant, for however well the imported roots may flower in England for the first season, they soon degenerate. It is, however, probable that this arises in some degree from want of skill in the cultivation; for some gardeners have been successful in growing the same roots for several years in succession. The compost used at Haarlem is rotten cow-dung, rotten leaves, and fine sand. The bed into which this compost is to be put must be taken out to the depth of 3 feet, its bottom made firm, and a few stones thrown into it in order to keep it dry. It must then be raised considerably above the level of the surrounding soil with the compost already prepared. The best season for planting is from October to the beginning of November, and the early sorts planted at this time will begin to show their flowers in the beginning of April.

As hyacinths are planted in autumn and bloom early in the season, they never require any water, and as soon as the flowering is over the drier the ground can be kept the better it is for the bulbs. When the leaves turn yellow and are withered, which will take place in about a month after the plants have gone out of flower, the bulbs must be carefully taken up and dried.

Hyacinths are frequently grown and flowered in water-glasses. Sometimes before they are put into the glasses they are planted in pots, and when the roots have grown a little they are taken up and washed, and then placed in the glasses, or they are placed in the glasses at first. The water must be frequently renewed, or it will soon become fetid and offensive. To prevent their growing long, weak, and pale, so as to flower badly, they should be kept close to a window, where they can be constantly exposed to bright light all day long. In order to secure their pushing out their roots before the leaves lengthen, they should always be kept in the dark for a fortnight or three weeks after they are first placed in the water-glasses, care being taken at that time that the water and the bulbs are not in contact. The moisture that rises into the air will be sufficient to induce the bulbs to put forth roots, and the total absence of light will prevent the leaves from being stimulated into growth.

The genus Hyacinthus belongs to the order LILIACEÆ, and is included by Bentham and Hooker in the same tribe, Scilleæ, as the squill. Our native bluebell is not, as it is sometimes called, a hyacinth, but belongs to the same genus, Scilla, as the squill. There are thirty species of Hyacinthus, of which three are natives of tropical or Southern Africa, and the rest belong to the East and Mediterranean region. The genus is characterized by the six-lobed tubular bell-shaped perianth; six stamens affixed to the tube or throat, the filaments being filiform or dilated at the base; the ovary three-celled, with a few ovules in each cell; fruit a capsule with obovoid or globose seeds; the bulb tunicate, and the flowers in a terminal raceme on a scape.

The original plant from which the cultivated varieties have been derived is a native of Southern Europe and the East, and is known to botanists as *Hyacinthus orientalis*. It was introduced into England from the Levant in 1596. The petals of this wild plant are narrow, wrinkled, pointed, and of a flimsy texture; but under cultivation they have become broad, smooth, solid, and rounded. The flowers have increased in size; their colours are diversified and intensified, and the whole spike has become more erect, longer, and broader. Gerarde mentions four varieties in 1597, and Parkinson eight in 1629. In a treatise published at Amsterdam in 1768 ("Des Jacinthes, de leur Anatomie, Reproduction, et Culture") it is stated that nearly 2000 varieties were known. At the present time not half this number are in cultivation, and this is probably due to the elimination of the less suitable kinds. At that time no instance was known of any variety reproducing itself truly by seed, but now both white and yellow kinds come nearly true.

Hyacinthus amethystinus is a native of the South of France and Spain, and of Croatia and Bosnia. It is somewhat like a squill in appearance. It has deep sky-blue bells on scapes 8 to 12 inches high.

The legend in connection with this flower is that Hyacinthus was a beautiful youth beloved by Apollo, and accidentally killed by him with a quoit. From his blood this flower sprang up, bearing on its petals dark streaks resembling the Greek lamentation **Αἰ, αἰ**, alas, alas.

Poets speak of curly hair as hyacinthine locks, probably in reference to the curled flowers of the hyacinth:—

> "And hyacinthine locks
> Round from his parted forelock manly hung
> Clustering."

HY'ACINTH or **JA'CINTH,** the name applied to the transparent red variety of ZIRCON; the colours vary somewhat, passing into orange and poppy red. It differs from JARGON only in colour, and is a valuable gem. It is mentioned as the first stone in the third row of the Jewish high-priest's ephod, and in the middle ages it was considered as symbolical of St. Simeon.

The gem now called sapphire is probably that known to the ancients as hyacinth. The hyacinth was formerly obtained from Upper Egypt. It is now got in the sands of Ceylon.

HY'ADS or **HY'ADES** are a little group of five stars, forming the face of the constellation of the Bull (Taurus). The word means "the rainy ones" in Greek, and was given to this little group because with their appearance in the sky the rainy season commenced. They were daughters of the Titan Atlas, and were set in the heaven, according to the version in the Greek mythology,

to reward them for their sisterly affection for their brother, Hyas, devoured by a lion. There were twelve altogether, the other seven making the sister group of PLEIADS. To them Zeus intrusted the care of the infant Dionysus; and it was because of his gratitude that they became stars, according to another version.

HYÆ'NA is a genus of CARNIVORA, forming the family Hyænidæ, which is intermediate between the cats (Felidæ) and the civets (Viverridæ), linked to the latter by the AARD-WOLF (Proteles), which forms a subfamily of Hyænidæ.

The hyænas are distinguished by having their fore legs longer than their hind legs, by their rough tongue, powerful jaws, projecting eyes, large ears, and a deep and glandular pouch beneath the anus. The dental formula is as follows:

$$I. \frac{3-3}{3-3};\ c. \frac{1-1}{1-1};\ pm. \frac{4-4}{3-3};\ m. \frac{1-1}{1-1} = 34.$$

The premolars are conical, blunt, and very large. The upper carnassial tooth has a small tubercle within and in front, but the lower one has none, and presents only two trenchant points. The structure of the teeth and of the whole skull appears to have been formed with a view to bringing into the most available action the formidable natural instruments which enable the animal to break the hardest bones. The hyænas are digitigrade, walking on their toes, of which there are four on all the feet. The claws are not retractile.

The hyænas are ferocious, cowardly, nocturnal animals, and in some countries where they swarm in legions are the dread of whole districts, in which, however, they in some manner repay the injuries they commit by their services as scavengers. They seldom attack men, unless forced in self-defence, but often carry away children, and destroy sheep, asses, calves, and even cows. The strength of their neck and jaws is prodigious, but their hinder quarters seem to be comparatively feeble, and they run along with a sort of shuffling gait. During the day they conceal themselves in caverns, amidst ruins, and in other obscure retreats. They are skulking, prowling, and, poetically speaking, mysterious beasts. Their wild howlings during the hours of darkness are well calculated to appal even man; and the timid beasts upon which they habitually prey crouch panic-stricken or take to flight.

The hyænas are confined to Asia and Africa, at least in the present day, and the following species are known:—

1. The Striped Hyæna (*Hyæna striata*) is the most widely distributed species, being found in abundance in the greater part of Central Asia, Hindustan, Asiatic Turkey, Persia, Syria, and Northern Africa. It is recognized by its brownish-gray colour, which is darker along the central line of the back and neck, where the hairs are prolonged to form an erectile mane, the sides of the body being also marked by several dark brown bands. This species feeds largely on carrion, seeking its food even in graveyards. The name Laughing Hyæna, applied to this and the following species, is scarcely deserved, for anything less mirthful or mirth-moving than their diabolical howlings could hardly be conceived. It is about the size of a wolf. Many proofs have been adduced to show that this species is capable of domestication. One kept in the Tower of London manifested remarkable docility and attachment to its keeper. Colonel Sykes states that in Central India, where the species is numerous, they are found as susceptible of domestication as ordinary dogs.

2. The Spotted Hyæna (*Hyæna crocuta*) is the Tiger-wolf of the colonists of the Cape, and is often spoken of simply as the wolf, in contradistinction to the next species, which is termed the Strand-wolf. Though most abundant in Southern Africa, the spotted hyæna is found as far north and west as the coast of Guinea and Senegal. It is rather smaller than the last-described species, and is further distinguished by the absence of any well-marked mane, as well as by the circumstance that the fur is covered with roundish black spots instead of stripes, which nevertheless exhibit a tendency to arrange themselves in linear series. The general colour of the fur is yellowish-brown, the hairs being comparatively short. The tail is bushy and of a brownish-black tinge. The habits of the spotted hyæna appear to be even more destructive than those of the striped species. This hyæna is the nuisance and even terror of South Africa, where it is well known to the farmers, who too often experience the effects of its destructive habits; for it not only devours the carrion which chance throws in its way, but it invades the farmers' pens or folds during the night, and often succeeds in killing or mutilating some of the live stock. Sickly animals are less liable to suffer from the voracity of this creature than those which are in full health; the latter by their rapid flight inspire the enemy with a courage of which by nature he is destitute, whereas the sickly face him, and thus intimidate him. When more common even the huts of the natives were not safe from its attacks, for it would enter them by night and carry off children. Notwithstanding this ferocity, the spotted hyæna has, it is stated, been domiciliated in the houses of the peasantry, among whom, says Mr. Bennet, he is preferred to the dog himself for attachment to his master, for general sagacity, and even, it is said, for his qualifications for the chase.

3. The Brown Hyæna (*Hyæna brunneas* or *villosa*) is the Strand-wolf of the Cape, so called from its frequenting the sea-coasts. The strand-wolf devours carrion and such dead animal substances, whales for instance, as the sea casts up; but when pressed by hunger its habits seem to resemble those of the other species, for it then commits depredations on the flocks and herds of the colonists, who hold its incursions in great dread. The hair of the brown hyæna is long and coarse, but it does not form an erectile mane along the central line of the back. The body has a grayish-brown colour, with indistinct markings of a darker hue, transversely arranged on the sides and hips, and other more conspicuous ones on the legs. The tail has a deep brown tinge, and is longer than in the ordinary striped hyæna. The head is lined with dark patches beneath the eyes, on the chin, and at the point of junction of the cheeks and neck. The ears are comparatively large, straight, and pointed. The brown hyæna is considered by some naturalists to be only a well-marked variety of the striped hyæna.

Fossil Hyænas.—Fossil hyænas occur abundantly in the later Tertiary deposits. The Cave Hyæna (*Hyæna spelæa*), which is scarcely distinguishable specifically from the spotted hyæna, roamed through Europe and Britain in the Pleistocene epoch. In Kent's Hole, a cave near Torquay, the bones of the cave hyæna are found in company with those of the cave bear, cave lion, and others. In Wookey Hole, near the Mendips, the bones of the cave hyæna are more abundant than those of any other animal.

HYÆNA DOG. See HUNTING DOG, CAPE.

HY'ALITE or **MULLER'S GLASS** is a transparent or semitransparent colourless variety of OPAL; it occurs in botryoidal or stalactitic forms, or in small lumps in some volcanic rocks. British localities are Newcastle, England, and Donald's Hill, County Down.

HY'BRID (Gr. *hubris*, wantonness, outrage) is the term applied to the offspring of a fertile cross between two distinct species; it must be distinguished from the term mongrel, which is applied to the offspring of a fertile cross between two varieties of the same species. Hybridism is of course an exceptional state of things, the general rule being that species when intercrossed are sterile. The laws governing the production of such forms are identical, or nearly identical, in the animal and vegetable kingdoms. The subject of hybridism, with its bearing on the theory of descent, has been fully treated by Darwin both in his

"Origin of Species" and "Animals and Plants under Domestication."

Two distinct kinds of sterility must be carefully distinguished—the sterility of two specific forms when first crossed, and the sterility of their hybrid progeny. The importance of this distinction lies in the fact that hybrids have their reproductive organs imperfectly developed.

Darwin combats the old doctrine that the mutual sterility of species is a special endowment in order to prevent the confusion of all organic forms by the admixture of specific qualities. This doctrine apparently receives support from the fact of the fertility of domestic varieties when intercrossed and that of their mongrel offspring. If it can be shown that the sterility of species and the fertility of varieties are universal rules, a broad distinction will be drawn between varieties and species. Darwin clearly demonstrates that no such absolute law can be laid down. The sterility of species when first crossed and that of their hybrid offspring varies in degree from absolute sterility up to complete fertility. A high degree of fertility in such cases is rare. An extraordinary instance is quoted by Darwin, in which every ovule in a pod of *Crinum capense* fertilized by *Crinum revolutum* produced a plant, an occurrence which the experimenter had never observed in a case of its natural fecundation. Plants belonging to species of the genus Hippeastrum, Lobelia, and Verbascum, and several genera of Orchids, can be more easily fertilized by the pollen of a distinct species than by their own pollen; in the case of certain orchids the observations of Fritz Müller prove that the pollen of the plant itself is actually poisonous and destroys the flower. Three species of the genus Passiflora never produce seed when fertilized with their own pollen, but are completely fertile when mutually crossed in various ways. Many hybrids of such plants as rhododendrons, fuchsias, and calceolarias are perfectly fertile.

Among animals hybrids between two specific forms are more common than in the vegetable kingdom, but the hybrids themselves are very rarely fertile. Thus the horse and the ass may be reciprocally crossed, the union between the he-ass and the mare producing the mule, and that between the stallion and the she-ass producing the hinny, but both hybrids are completely sterile. The dog breeds freely with the wolf, but the hybrids again are sterile. The hybrids between domestic breeds of fowl and wild species of the genus Gallus are nearly always sterile. Hybrids are produced between the hare and the rabbit, which are said to be fertile when crossed with either of the parent species. A remarkable exception to the general rule is furnished by the cross between two species of geese: the Chinese goose (*Anser cygnoides*) is so distinct from the common goose that it is often removed from the genus Anser and ranked in a distinct genus, Cygnopsis, yet the hybrids between these two forms often breed freely with either parent species, and more rarely *inter se*. Animal hybrids occur, though rarely, between distinct generic forms, but never between two forms belonging to distinct families.

There is no fixed relation between the degree of sterility of a first cross between two species of animals or plants, and that of their hybrid offspring. "Many cases are known of species which can be crossed with ease, but yield hybrids excessively sterile; and conversely some which can be crossed with great difficulty, but produce fairly fertile hybrids."

The degree of sterility in two species when reciprocally crossed often differs remarkably. Thus the mule, the hybrid between the he-ass and the mare, is more readily obtained than the hinny, the result of the union of the stallion and she-ass. In other cases, while the male of one specific form will readily fertilize the female of another, the male of the latter is incapable of fertilizing the female of the former.

The following rules governing the fertility of first crosses and of hybrids are given, among others, by Darwin:—(1) The fertility of first crosses and of hybrids, besides being eminently susceptible to favourable and unfavourable conditions, is innately variable. (2) The fertility of hybrids is not related to the degree in which they resemble in external appearance either parent. (3) The facility of making a first cross between any two species is not always governed by their systematic affinity or degree of resemblance to each other.

From a consideration of all the facts, Darwin comes to the conclusion that the sterility of first crosses and of hybrids is not a special endowment, but "is simply incidental or dependent on unknown differences, chiefly in the reproductive systems, of the species which are crossed." It is a well-established fact that the reproductive system is peculiarly sensitive to changed conditions of life; in many cases animals will not breed in captivity. The cause of the sterility of hybrids seems of a similar nature, since their organization has been disturbed by the blending of two different natures into one. The sterility of first crosses seems to depend in some cases on the early death of the embryo.

The general rule that domestic varieties, such as those of the dog, fowl, pigeon, and plants producing useful fruits or vegetables, are perfectly fertile when crossed, must now be considered. To this rule there are several exceptions among plants. Complete mutual sterility has been shown to exist in the case of certain varieties of maize, and a high degree of sterility in varieties of Verbascum, gourd, melon, and one kind of tobacco. Our domestic breeds must have descended from species whose reproductive organs were not easily affected in the direction of sterility by their changed conditions of life. If, then, the parent species, when first domesticated, retained their fertility more or less unimpaired, it seems natural that the effects of domestication should tend to increase fertility. The doctrine of Pallas that domestication tends to eliminate sterility is upheld by Darwin. For instance, the domestic varieties of dogs are all freely fertile among themselves, though undoubtedly derived from wild species, which when first crossed must have exhibited some degree of sterility.

HY'BRIDS, in etymology, are those words which are made up of words, or parts of words, taken from various sources. It is impossible to avoid the use of hybrids, but certainly the best writers endeavour to keep down their use. *Criticise* is an accurately formed word, for example: it is a Greek root with a Greek ending; but *civilize* is a hybrid, for it has a Latin root and a Greek ending. The chief classes of hybrids in our tongue are the following, a few typical examples being given of each:—

(1) English words with Romance suffixes. *Hindr*ance (and others in "ance"), *bond*age (and others in "age"), *knav*ery, &c.; *god*dess, &c.; *eat*able, &c.; *wondr*ous, &c.

(2) English words with Romance prefixes. En*dear* (and other words with "en"); dis*believe*, &c.; re*take*, &c.

(3) Romance words with English suffixes. Savage*ness*, &c.; savage*ly*, &c.; duke*dom*, &c.; use*ful*, &c.; use*less*, &c.; quarrel*some*, &c.; fever*ish*, &c.

(4) Romance words with English prefixes. *Be*siege, &c.; *under*value, &c.; *un*stable, &c.; *over*turn, &c.; *after*-piece, &c.

Classical hybrids are referred to sufficiently above. It remains only to notice those words formed by mere agglutination, which can hardly be said to be words except by the good grace of the printer's hyphen, and therefore can scarcely deserve the name of hybrids. Such are mob-o-cracy, neck-hand-kerchief, &c.

HYDAS'PES, the classical name of the Jhelum, one of the "Five Rivers" (Punjab) whose confluence makes up the Indus. Alexander's great victory over Porus, which opened India to his arms (had not his soldiers insisted upon turning back) was fought, B.C. 327, on the banks of the Hydaspes, at or near the very spot afterwards the scene of our own bloody fight of Chilianwala.

HY'DATIDS (Gr. *hudatis*, a vesicle, from *hudōr*, water). This name has been applied to various bladder-like objects, which are sometimes found in the bodies of men and animals, the nature of which was for long unknown. They are now found to be stages in the life-history of various species of TAPEWORM.

Hydatids may be developed slowly, and occasion so little inconvenience that persons in whom they have been discovered after death may not have suspected disease of the organ in which they existed during life. Occasionally they cause so much irritation that suppuration may take place either around or within the common sac, which may burst externally or into a serous or mucous cavity. In either the first or last case the hydatids will be discharged, and the patient may recover; but if the cyst should communicate with a serous cavity, as the peritoneum or pleura, fatal inflammation will occur. With respect to the treatment for the prevention or removal of hydatids, it must necessarily, from the obscure notion of the symptoms of the presence of these animals, be of a very uncertain kind.

False hydatids are vesicular bodies, either entirely or partially connected with the tissues by which they are surrounded. Of this nature are the cysts containing fluid in ovarian dropsy.

HYDE, EDWARD, EARL OF CLARENDON. See CLARENDON, EARL OF.

HYDE PARK, an inclosure of about 390 acres, forming an excellent place for open-air recreation in the heart of the west-end of London. It was formerly known as *Hida Manor*, and belonged to Westminster Abbey, but became crown property on the dissolution of the monasteries in the reign of Henry VIII. In the year 1550 the French ambassador hunted with the king in Hyde Park, which was then well stocked with game and kept as a royal inclosure. Nearly the whole of Kensington Gardens were then included in the park; the separation was not made till the time of George II., but they still remain virtually an extension of Hyde Park, and bring the whole space into one area. The Serpentine is a long canal-like piece of water, covering 50 acres, which was formed by the order of Queen Caroline out of a number of small ponds, and is much used for rowing, bathing, and skating. Hyde Park has been fashionable for drives and promenades ever since the reign of Charles II. Rotten Row is a road in it devoted exclusively to equestrian exercise, where the fine gravel is always allowed to remain loose. Adjoining this road the International Exhibition Palace of 1851 was built. The carriage drive on the northern bank of the Serpentine is called The Ladies' Mile. Near the Piccadilly entrance, and opposite Apsley House, stands Sir R. Westmacott's bronze statue of Achilles, erected in honour of the great Duke of Wellington.

HYDERABAD' (*Haidarabad*), the Nizam's Dominions, a native state or feudatory kingdom of British India, roughly co-extensive with the Deccan (*Dakshin*) or central plateau of Southern India, which takes its name from its capital, Hyderabad City. The form of the territory, inclusive of the Hyderabad Assigned Districts, known as Berar, is that of a trapezium. Its base is about 420 miles in a direction from north-east to south-west; it is 475 miles in length from south-west to north-east, and about the same distance in breadth. The area of Berar is 17,728 square miles, that of the remaining portion of the Nizam's Dominions is estimated at about 80,000 square miles; the total area of the whole state being thus about 98,000 square miles. It is bounded on the north and north-east by the Central Provinces; on the south and south-east by territory subject to the Presidency of Madras; on the west by territory subject to the Presidency of Bombay. Within the western part are some small isolated British possessions. Hyderabad is a tract of considerable elevation, averaging 1250 feet above the level of the sea, and some granite summits attain a height of 2500 feet. With the exception of the valley of the Tapti at the northern extremity of the territory, which is bounded on the north by the Vindhya range and on the south by the high land of the Godavari, the whole drainage of the country is either from west to east or from north-west to south-east, discharging into the Bay of Bengal by the channels of the Godavari and the Kistna. The drainage of the valley of the Tapti, flowing westward, falls into the Gulf of Cambay. This wide expanse of country presents much variety of surface and feature. In some parts it is mountainous, wooded, and picturesque; in others, flat or undulating. The champaign lands are of all descriptions, including many rich and fertile plains, much good land not yet brought under cultivation, and numerous tracts too sterile ever to be cultivated at all. In the north-west the great volcanic formation, extending through the greater part of the Deccan, consists principally of trap, but in some parts of basalt. In the middle, southern, and south-western parts, the greater part of the country is overlaid with gneissic formations. In the north-east, along the right bank of the Godavari, there is much sandstone, some of it carboniferous. Near the junction of the Pengangа with the Wardha, and in the valley of the latter river, there are coal-fields. Those which have been examined over a small area near Sasti and Paoni show an average of 40 feet in thickness. The quality of the coal hitherto mined is inferior to that of Raniganj, but good enough for railway purposes. Iron ore is found in the same neighbourhood, also limestone and *kankar*, or nodular limestone, at Kamaram in the extreme east; and 100 miles north-east of Ellore there is also a small coal-field. At Shahabad, near the junction of the Great Indian Peninsula Railway with the Nizam's State Railway, are quarries of excellent limestone, which are extensively worked for a considerable distance along the line of the latter railway. The stone found is of two colours, gray and black, and takes a polish almost equal to marble. It is used in large quantities for building purposes, for which it is well suited from its regular cleavage and the ease with which it can be worked.

The Hyderabad territory is, on the whole, well watered, rivers being numerous and tanks or artificial pieces of water very abundant. The Godavari is the chief river, its total length along the border and through the territory being about 600 miles, for above 200 of which it is navigable from June to February. Tanks are numerous, and some of them are of very great size, as that at Pakhal, which is at least 30 miles in circuit. They are generally formed by throwing an embankment across the lower end of a valley, and thus causing the accumulation of the water of such streams as may flow into it.

The climate may be considered in general good; and as there are no arid, bare deserts, similar to those of Rajputana and some other tracts of Northern India, the hot winds are less felt. Ophthalmic diseases are prevalent in the sandstone district. The wells in general yield impure, unpalatable water, productive of disease, caused by the Dracunculus or guinea-worm, from which those who use the water from tanks or streams are exempt. The annual fall of rain is estimated at from 28 to 32 inches at Hyderabad; this occurs principally during the south-west monsoon between June and October.

The soil is in general fertile, though in some parts it consists of *chilka*, a red and gritty mould, little fitted, from the coarseness of its particles, for purposes of agriculture. Resembling this, but composed of particles more minute, is *lal-zamin*, a soil also of a reddish hue, and considered to be formed of the remains of broken-down ant-hills, which are surprisingly numerous in this country. The peculiar acid (the formic), which is their chief constituent, acts upon the alkali and lime, and most probably on

the silica of the rock debris, pulverizing it and facilitating, in all probability, fresh combinations. Though less extensive than the kinds just enumerated, the *regar* or black cotton soil occurs in many places, is esteemed the best of any, and, as indicated by the epithet above applied to it, is peculiarly suited for the cultivation of cotton. It requires no manure, except that left by sheep, generally fed upon it when under fallow previous to cultivation. This is, however, an important resource, as flocks of sheep are everywhere to be seen. Throughout this territory the ground, wherever left uncultivated, even but for a year or two, becomes covered with a low jungle. The toddy palm, *Borassus flabelliformis*, and *Phœnix sylvestris* are extensively cultivated on account of their sap, which is drawn off and fermented into an intoxicating beverage. The principal grain crops are rice (of which there are no less than eight varieties), wheat, maize of various kinds, mustard, and the castor-oil plant; melons, cucumbers, and gourds are largely grown, and form important articles of diet. The gardens produce onions, garlic, carrots, radishes, potatoes, sweet potatoes, coriander, ginger, turmeric, and various kinds of amaranth used as pot-herbs. Tobacco is cultivated, but not to a great extent. Cotton, indigo, and sugar-cane are the more important objects of the agriculturist's care. Valuable dyes occur wild and are also cultivated. Fruit of many different kinds is plentiful. The mango and custard-apple grow wild over large tracts. The melons and pine-apples of Hyderabad are as celebrated in their way as the oranges of Nagpur, and the large purple grape of Daulatabad is exported to many distant markets. Plants rich in textile fibre are not less abundant. *Tasar* silk, the produce of a wild species of worm, is everywhere gathered in the jungles. Hides, raw and tanned, both of domesticated and wild quadrupeds, are articles of some importance in commerce. Wild bees swarm in all the jungles, consequently wax and honey are very abundant and cheap. Lac, suitable for use as a resin or a dye, may be obtained in quantities far beyond the present demand. Mucilaginous gums are produced in the woods in inexhaustible quantities, and there are some considered not inferior in quality to the best African gums.

No census of the population has been attempted in the Nizam's Dominions, with the exception of Berar or the Hyderabad Assigned Districts, which are under British administration. The population of Berar has been estimated at 2,250,000, and that of the remainder of Hyderabad territory at 9,000,000. There is a considerable intermixture of the people speaking different languages. The Marhattas are most numerous in the west. The Mussulmans are chiefly to be met with in the capital and everywhere in the civil and military service of government. In addition to the Hindu and Mohammedan population, there is a large admixture of Parsees, Sikhs, Arabs, Rohillas, aborigines, and others. Owing to the general distribution of arms among all classes, the people of Hyderabad, as of other native states, present to the casual observer a more formidable appearance than is borne out, perhaps, by anything in their actual character or disposition. The Telingas or Telugu-speaking folk, though not in a highly advanced state of civilization, are by no means sunk in barbarism. They generally inhabit straggling villages, in houses built of mud, with pyramidal roofs of palmyra leaves, though a few dwellings are more substantially constructed of brick and tiled. In some of the less civilized parts, the habitations are mere sheds of palmyra leaves, or hovels made of bamboos and wattle. There is usually to each village a detached fort, constructed either of masonry or mud, about 50 yards square, and containing the dwellings of the *zamindar* and his immediate dependants. There is a considerable proportion of Brahmans among the Telingas; and the usual diet of these and the higher classes consists of rice in some localities and of wheat and *joar* in others, with vegetable curries, and cakes flavoured with garlic or asafœtida and fried in butter. The Brahmans profess to abstain from animal food; but the *zamindars* of the Kumbi caste consume mutton, poultry, and game. The lower orders subsist on *ragi* and other inferior sorts of grain; all are addicted to intoxication with the fermented sap of various kinds of palms and spirit distilled from the flowers of the *mahua* (*Bassia latifolia*). Tobacco is generally used, both for smoking and chewing, as well as in the form of snuff. Bhang, or the intoxicating narcotic obtained from hemp, and opium are also in use, but to no great extent. The Gonds, who lurk in the hills and fastnesses, are a wild and savage race; they may, however, be rendered tractable and obedient by kind treatment. At present the majority are nearly in a state of nature, sheltering in caves or hollow trees, and feeding on game when obtainable, at other times on vermin, reptiles, and wild roots or fruits.

The principal items of export are cotton, oil-seeds, country cloth, hides, metal ware, and agricultural produce; those of import are salt from the eastern and western coasts, grain, timber, European piece-goods, and hardware. The railway connecting Bombay with Madras traverses the south-western part of the state. The Great Indian Peninsula Railway runs as far as Raichur, where it is joined by the Madras Railway. At Wadi, 7 miles from the station of Shahabad, on the Great Indian Peninsula line, the Nizam's State Railway branches off to Hyderabad and to the military cantonment of Secunderabad (Sikandrabad). From Hyderabad two lines of telegraph separate, one going south-west to Bellary, the other with an easterly direction towards Masulipatam, near the mouth of the Kistna. The principal roads are the military ones. The annual revenue of the Nizam's Dominions, Berar included, may be stated in round numbers at £4,000,000, inclusive of receipts from all sources. About two-thirds of the above large sum is collected by the Nizam's own government from tracts under native rule. The remaining one-third is realized by British officers principally from Berar. All revenue collected by the British government from districts owning the sovereignty of the Nizam is either spent in administering and opening up those districts, or is handed over to him as unexpended balance or surplus. The Hyderabad government has a mint and a currency of its own.

The dynasty of the Nizam was founded by Asaf Jah, a distinguished general of the Mogul Emperor Aurungzebe, of Turkoman descent. After a long life at the Delhi Court, distinguished alike in war and political cunning, he was in 1713 appointed Subahdar or Viceroy of the Deccan, with the title of Nizam-ul-Mulk (Regulator of the State), which has since become hereditary in the family. The Mogul Empire was at this time torn by internal dissension, and at the same time threatened by the rising power of the Marhattas. Amid the general confusion, Asaf Jah had little difficulty in asserting his independence against the degenerate descendant of Aurungzebe, though he was less successful in repelling the inroads of Marhatta cavalry. At his death in 1748, he was firmly established as an independent sovereign, with Hyderabad for his capital and a kingdom roughly co-extensive with the present state. On the fall of Seringapatam and the death of Tippoo Sultan, the Nizam participated largely in the division of territory under the partition treaty of 1799.

By a treaty of 1800, the Nizam agreed to furnish in time of war 6000 infantry and 9000 cavalry to co-operate with the British army, and to employ every effort to bring into the field as speedily as possible the whole force of his dominions. But his troops proved very inefficient in the first Marhatta war, and after the conclusion of the campaign various schemes were from time to time proposed for their reform with little success. Eventually battalions were raised which were clothed, armed, and equipped like

the company's troops; and for the regular payment of this contingent advances were made in 1843 from the British treasury on the distinct understanding that in the event of further advances becoming necessary a territorial security for the payment of the debt would be demanded. No efforts, however, were made to pay off the debt, which continued to increase. At last, in 1853, a new treaty was concluded, by which the British government agreed to maintain an auxiliary force of not less than 5000 infantry, 2000 cavalry, and four field batteries, and to provide for its payment and for certain pensions and the interest on the debt; the Nizam on his part agreed to cede in trust districts yielding a gross revenue of 50 lacs of rupees (say £500,000). By this treaty the Nizam, while retaining the full use of the subsidiary force and contingent, was released from the unlimited obligation of service in time of war; and the contingent ceased to be part of the Nizam's army, and became an auxiliary force kept up by the British government for the Nizam's use. In 1857, when the Sepoy mutiny broke out, the condition of Hyderabad and the Nizam's Dominions became critical; and in July an attack, which was repulsed, was made upon the Residency. The Hyderabad contingent displayed its loyalty in the field against the rebels. In 1860 a fresh treaty was made by which the territorial acquisitions of the Nizam were increased, a debt of 50 lacs of rupees was cancelled, and the Assigned Districts in Berar, yielding a gross revenue of 3,200,000 rupees (say £320,000), were taken in trust by the British government for the purposes specified in the treaty of 1853. Under British administration the revenues of Berar have greatly increased. The surplus is paid over to the Hyderabad State. The Nizam is the chief Mohammedan ruler in India, and is entitled to a salute of twenty-one guns.

Hyderabad, the chief city and capital of the above state, is situated on the river Musi, which is at this part between 400 and 500 feet in width. It stands at a height of about 1700 feet above sea-level, and is distant 389 miles north-west from Madras, 449 south east from Bombay, and 962 south-west from Calcutta. The population of the town is estimated at 200,000. The scenery around Hyderabad is wild and picturesque, the country being hilly and dotted with numerous granite peaks and isolated rocks. Approached from the west, the appearance of the city is very striking; the palace and mosques and magnificent pile of buildings erected for the British Residency towering above the lower walls. A large lake, a few miles south of Hyderabad, supplies the town. When full, this sheet of water is nearly 20 miles in circumference, and covers an area of 10,000 acres.

The palace of the Nizam, the mosques, and the British Residency are the principal buildings; the first has, however, no pretensions to splendour, but is of considerable size. Hyderabad is a great Mohammedan stronghold, and contains several mosques. The *Jama Masjid* or "Cathedral" Mosque, so called after the one at Mecca, from which it is designed, is large, and crowned by minarets of an extraordinary height. The pillars within consist each of a single piece of granite, and are very lofty. In the environs of Hyderabad there are many fine gardens with gorgeous pavilions. One of the most interesting places in Hyderabad is the college or *Char Minar* (so called from its four minarets), built upon four grand arches, at which the four principal streets of the city meet. Above are several storeys or rooms, and formerly each storey was devoted to a science. These apartments are now turned into warehouses. On the north side of the Musi is an extensive suburb known as the Begum or "Princess" Bazaar, because the imports levied there are a perquisite of the Nizam's principal wife. The British Residency is in this quarter, and communication between it and the palace of the Nizam is maintained by a handsome bridge 24 feet wide. The Residency is remarkable, among other things, as having been constructed entirely by native workmen. The staircase is the finest in India, each step a single block of the finest granite; the walls are richly decorated, and the apartments are furnished with the utmost luxuriance. The pavilions, galleries, and terraces are ornamented in the florid style of Oriental architecture, with a profusion of delicate trellis-work, painting, and gilding.

HYDERABAD' (*Haidarabad*), a British district in the Commissionership of Scinde, Bombay, lying between 24° 13′ and 27° 15′ N. lat., and 67° 51′ and 69° 22′ E. lon. The area is 9000 square miles, and the population 750,000. The district is a vast alluvial plain, 216 miles long by 48 broad. Fertile along the course of the Indus, which forms its western boundary, it degenerates towards the east into sandy wastes, sparsely populated, and defying cultivation. The monotony of its great flats is relieved only by the fringe of forest which marks the course of the river, and by the avenues of trees that line the irrigation channels branching eastward from the beneficent stream.

Agriculture in Hyderabad is entirely dependent upon the artificial irrigation carried on by means of canals, which can be divided into three classes—(1) where the water has all the year round to be raised by machinery; (2) where at high flood the water will without artificial aid fill the canal; (3) where machinery is never required, the land lying so low as to be subject to inundation at every rise in the river. All three tend to make cultivation imperfect. In the first case the cost of raising the water, estimated at 8*s.* the acre—twice as much as the land assessment—prevents any large recourse to it; in the second the cultivator is tempted to trust to luck, and thereby save expenditure on lifting apparatus; in the third the fields lie at the mercy of the most treacherous of rivers. Agriculture, it has been said of this district, is looked upon as a lottery, in which the cultivator stakes a certain amount of labour and seed on the chance of getting an exactly suitable flood. If the water rises too high, or not high enough, he loses his crop. The result is a bad cultivation, for the majority of the cultivators risk only the careless preparation of a small patch, which, if a prize turns up, will suffice for their wants; and if a blank, will not seriously embarrass them.

The manufactures of the district maintain the excellence for which they have been famous from early times. The Hyderabad *táluk* in particular still enjoys much of its old pre-eminence for lacquered work, enamelling (the secret, it is said, of one family only), and gold and silver embroidery. Special features of the local industry are also striped and brilliant cloths known as *súsis* and *khesis*, and glazed pottery. This effective work is turned to various ornamental purposes, especially tiling, and is remarkable for excellence of both glaze and colour. Salt is produced in sufficiently large quantities to allow, after local consumption, of a considerable exportation. In nearly all the villages of the district some manufacture is carried on; blankets, coarse cotton cloths, camel saddles, and metal work being perhaps the most prevalent.

Hyderabad, the chief town of the above district, has a population of 36,000. It is built on the most northerly hills of the Ganja range, a site of great natural strength, 3½ miles east of the Indus, with which it is connected by the highroad to Gidu-Bandar, where a steam ferry crosses the river to Kotri on the Scinde Railway. In the fort, which covers an area of 36 acres, are the arsenal of the province, transferred hither from Karachi (Kurrachee) in 1861, and the palaces of the ex-Mirs of Scinde. The city is the centre of all the provincial communications—road, telegraphic, postal. From the earliest times its manufactures—ornamented silks, silver and gold work, and lacquered ware—have been the chief of the province, and in recent times have gained prizes at the

industrial exhibitions of Europe. A local specialty is the manufacture of the earthen vessels, *mati*, used by the *pala* fishermen to buoy themselves on the water while fishing.

HYDERABAD ASSIGNED DISTRICTS, or **BERAR′,** a province in Central India, administered by a British officer, entitled the Commissioner of Berar, under the Resident at Hyderabad. It is bounded on the north and east by the British Commissionership of the Central Provinces, on the south by the Nizam's Dominions, and on the west by the Bombay Presidency. The area is 17,728 square miles, and the population 2,672,673.

Berar is, in the main, a broad valley running east and west, lying between the Satpura range on the north and the Ajanta range on the south. The real strength of the province is found in the valley at the base of the Satpuras. This valley is watered or drained, as the case may be, by the Purna (an affluent of the Tapti), and a perfect network of streams descending into the main river both from the hills in the north and from the hills in the south. Its soil is one vast superstratum of black loam overlying trap and basalt. Its rainfall is regular and copious; its area is now entirely cultivated. The population is dense, and consists of Kumbis and other hardy and industrious agricultural tribes. It is traversed from west to east of its whole length by the railway from Nagpur to Bombay. It possesses one of the richest and most extensive cotton fields in India, and several cotton marts of the very first rank. Its other products, especially millet and oil-seeds, are also excellent. Altogether it is one of the most promising regions in India; and in respect to natural and material advantages it surpasses any tract in either the Central Provinces or the Deccan. Iron ore is plentiful throughout large tracts in the east, especially on the hills near Karanja, and along the low range close to Amraoti on the north-east. It is not worked by the natives, and the proportion of iron in the ore has not been scientifically determined. The only district within Berar which yields coal is that of Wun, where, stretching along the valley of the Wardha River in a direction roughly north and south, there is a group of beds of thick coal of fair quality.

In consequence of the total bankruptcy of the Hyderabad state in 1853 a treaty was agreed to, under which the existing Hyderabad contingent force is maintained by the British government, in lieu of the troops which the Nizam had been previously bound to furnish on demand in time of war; while for the payment of this contingent, and other claims on the Nizam, districts yielding a gross revenue of 50 lacs of rupees were assigned to the British. It was agreed that accounts should be annually rendered to the Nizam, and that any surplus revenue should be paid to him. On his part he was released from the obligation of furnishing a large force in time of war; while the contingent ceased to be part of the Nizam's army, and became an auxiliary force kept by the British government for his use. The provisions of the treaty of 1853, however, which required the submission of annual accounts of the Assigned Districts to the Nizam, were productive of much inconvenience and embarrassing discussions. To remove these difficulties, and at the same time to reward the Nizam for his services during the mutiny of 1857, a new treaty was concluded in December, 1860, by which a debt of 50 lacs due by the Nizam was cancelled and various territories were restored to him. On the other hand, the Nizam ceded certain districts on the left bank of the Godavari, traffic on which river was to be free from all duties; and agreed that the remaining Assigned Districts in Berar, together with other districts, yielding a gross revenue of £320,000, should be held in trust by the British government for the purposes specified in the treaty of 1853; but that no demand for accounts of the receipts and expenditure of the Assigned Districts should be made. The province has rapidly progressed under British rule.

HY′DER-ALI-KHAN-BAHADOOR, Sultan of Mysore, a formidable opponent of the British rule in Hindustan, and son of the chief general of the Rajah of Mysore, was born in 1717. Until the age of thirty-three he was comparatively unknown. In 1750 he commanded a contingent against the Marhattas, fighting in concert with the French. Ascending step by step, in 1759 he reached the rank of commander-in-chief of the Rajah of Mysore. After one or two turns of fortune, Hyder not only established himself firmly as prime minister, but pensioned off his master with 3 lacs of rupees yearly, and became in 1761 the undisputed ruler of Mysore. From this moment he applied diligently and successfully to the increase of his power. His encroachments led to an offensive alliance between the Marhattas, the Nizam, and the late East India Company; but he found means not only to break up this confederacy, but to engage the Nizam in war against his late friends the British, in 1767. This war was carried on, little to the advantage of the British, for two years, when at last Hyder, by a bold and able stroke, placed himself in a position to prescribe terms of peace, of which the chief conditions were a mutual restitution of conquests, and an alliance in defensive wars. In 1770 the Marhattas invaded Mysore and reduced Hyder to great extremities. He recovered himself, however, and in 1780 burst with a vast army into the Carnatic. He met with continual success, and refused any terms of peace. The war, therefore, continued on the same footing until Madras was reduced to a frightful state of famine, when the death of Hyder, in November, 1782, relieved the English from danger. His son, Tippoo, concluded peace on the terms of a mutual restitution of conquests.

HYD′NUM is a genus of Fungi belonging to the HYMENOMYCETES (see Plate FUNGUS, fig. 5). The hymenium or surface which bears the spores is spread over the surface of spines or teeth, which are distinct at the base, and not over gills, as in AGARICUS, or lining tubes, as in BOLETUS.

Hydnum repandum is an esculent fungus, and is a delicacy if carefully cooked. It grows commonly on the ground, in woods, in patches or rings. The cap or *pileus* is fleshy, rather waved, with an irregular stem. The whole fungus, including the teeth, is of a pallid colour. To dress it the specimens must be quite fresh and free from insects, and after being sliced into hot water and gently pressed, should either be carefully stewed or rubbed down into a *purée* (M. J. Berkeley). *Hydnum coralloides*, figured in the Plate FUNGUS, is also an edible species; it is found on decayed fir, beech, &c., but is rather rare.

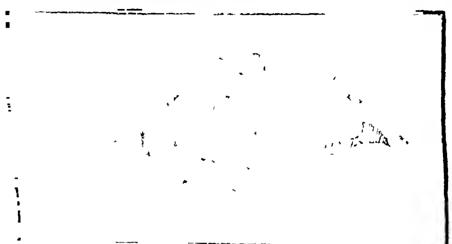
HY′DRA (Gr. *hudōr*, water), the water-snake or marsh-dragon, a fabulous monster, to destroy which was one of the twelve labours of Herakles. Its origin is uncertain, some making it the issue of Styx and the Titan Pallas, and others of Echidna and Typhon. It was sent by Hera to poison with its breath the pestilent marshes of Lerne, in Argolis. The number of its heads, which grew up again as often as they were cut off, is variously stated at from nine to 100. A subtle and deadly poison issued from its numerous mouths. See HERAKLES.

HY′DRA, the Sea-serpent or Water-snake, one of the old constellations of Ptolemy. From the time of Aratus downwards it has always been a triple figure; a long snake, represented as trailing upon the ground, bears upon his back a cup (Crater), and nearer his tail is seated a crow (Corvus). The mythological meaning is altogether unknown.

The great length of this constellation, the longest and perhaps the largest of all, has caused it to be divided into four parts, which are designated as Hydra, Hydra et Crater, Hydra et Corvus, and Hydræ Continuatio. The first contains the head and body up to about ten and a half hours of right ascension, all near to and south of the bright star Regulus; the second contains the cup and the parts

of the body adjacent; the third the crow, with the parts of the body adjacent; and the fourth (beginning at about thirteen hours of right ascension) contains the tail. Hydra is well seen in the south in the months of April and May. It contains one very bright star, the *Cor hydræ*, or "serpent's heart," also called *Alphard*, "the solitary one." It orginally extended along the equator, and may have stood for the great serpent which in many of the ancient mythologies encircled the world. It is shown in the Plates CONSTELLATION, the bulk of it extending along the right hand of the map of the southern hemisphere, the head being in the northern hemisphere. The sky is not altogether free of Hydra for five entire months (March to July).

HY'DRA is a genus of Polypes, forming the family Hydridæ of the class HYDROZOA. The genus Hydra contains the fresh-water polypes, of which two species (*Hydra viridis* and *Hydra fusca*) are common in ponds attached to water-weeds, especially the duck-weed. The hydra has a sac-like body, cylindrical in shape, and attaining a length of about a quarter of an inch. The mouth is situated at the extremity of the free end of the body, and is surrounded by a circlet of delicate threads, the tentacles, which vary in number from five to twelve. The whole body is very contractile, and shrinks at a touch into a rounded mass, the tentacles also shortening. When a small animal, such as the common water-flea (*Daphnia pulex*), while swimming about in the water, happens to touch one of the tentacles it is instantly grasped. The tentacles contract and drag down their prey into the mouth. From the mouth the victim passes into the general cavity of the body, for the hydra has no separate digestive cavity. Within the body-cavity the process of digestion goes on till all the nutritious matter has been absorbed, when the residuum is rejected through the mouth. The hydra is not permanently fixed, but can crawl in the manner of the looping caterpillars (Geometridæ). Bending over



The Hydra.

its body till its tentacles touch the foreign body to which it is attached, the hydra suddenly detaches its base The base then moves forward, and the body is bent so to enable it to take up a new position of attachment; the tentacles are then leased. By a repetition of the same process the hydra is enabled to make some progress Sometimes the hydra sets itself free from any attachment. and floats passively in the water with its base upward.

The reproduction of the hydra during the greater par of the year is by gemmation or budding, small tubercle appearing on different parts of the parent animal; an these tubercles separate on arriving at maturity. In warn weather the young hydræ, by the process of gemmation are produced very rapidly; and, what is still more extraordinary, the young ones themselves often breed others and those others sometimes push out a third or fourth generation before the first fall off from the parent. Wonderful as these modes of reproduction may appear, the are surpassed by the artificial multiplication of the animal by the division of the body. This was discovered by Trembley, in his "History of Polypes," in 1774. He says, "I have opened a polype on my hand, extended it, and cut the simple skin of which it is formed in every direction; I have reduced it to little pieces, and, in a manner, minced it. These little pieces of skin, both those which did and those which did not possess arms, became perfect polypes."

In the summer the hydra reproduces its kind by means of eggs. A large outgrowth of the surface is formed at the lower part of the body; this is the ovary. Nearer the mouth similar outgrowths, which are the testes, are formed. The ovary contains a single egg-cell, which after fertilization gradually breaks up into a number of cells enclosed in a capsule, and drops away from the parent; the embryo in the spring escapes from the capsule and gradually develops its tentacles.

The substance of the body of the hydra, like that of all Hydrozoa, is composed of two membranes, the inner being known as the endoderm, and the outer, a protective layer, the ectoderm. The free surface of the endoderm, is ciliated. The large ectodermal cells end in muscular processes. Scattered among the cells of the ectoderm are the *nematocysts* or thread-cells, oval cells containing a long coiled-up thread, which on pressure is shot out, and is supposed to have a stinging property. "The hydra has none of the special apparatuses which are termed senso-organs or glands. The cavity of the body alone represents a stomach and intestine; there are no organs of circulation, respiration, or urinary secretion; the products of digestion being doubtless transmitted by imbibition from cell to cell, and those of the waste of cells exuded directly into the surrounding water" (Huxley).

Two species of hydra are common in our ponds. The commonest of these (*Hydra viridis*) owes its green colour to an immense number of chlorophyll grains imbedded in the protoplasm of the cells of the endoderm. The Brown Hydra (*Hydra fusca*) has brownish and colourless bodies in its endodermal cells. It may also be distinguished from the common species by having its tentacles longer than the body.

HYDRACH'NA. See ACARIDEA.

HY'DRAMIDES. These compounds are formed by the action of ammonia on the aldehydes. All are crystalline and soluble in alcohol, but insoluble in water. The best known are furfuramide ($C_{15}H_{12}N_2O_3$), hydrobenzamide ($C_{21}H_{18}N_2$), and hydrosalicylamide ($C_{21}H_{18}N_2O_3$).

HYDRAN'GEA, a well-known genus of hardy shrubs belonging to the order SAXIFRAGEÆ. *Hydrangea hortensis* is commonly cultivated for the sake of its beautiful flowers. It is a native of China and Japan, and was originally observed in the gardens of Canton by Loureiro, who took it for a primrose, and called it *Primula mutabilis.* When this plant is hardy enough to survive the winter, it grows to a considerable size, and when covered by a multitude of its very large round heads of rosy flowers, becomes a magnificent object. To grow it in perfection it should be planted in the open ground in rich soil. During winter it should be covered with a mat well stuffed with straw. In the summer it must be abundantly supplied with water. It was introduced from China in 1790 by Sir Joseph Banks. The part of the flower which looks like a corolla is only an abnormal expansion of the calyx, and those flowers which have this expansion are deficient in stamens and pistil. The flowers are said to change from a rose to a blue colour, when the shrub is transplanted to a soil containing more iron.

The genus is distinguished by four or five valvate petals, eight to ten stamens inserted at the base of an epigynous disc, an inferior ovary two to four-celled (sometimes incompletely) with two to four styles, and fruit a capsule. The species are trees or shrubs with opposite simple leaves without stipules; they are thirty-three in number, and are natives of Eastern Asia, Japan, Java, the Himalayas, as well as North-east and South-west America.

HYDRANZOTIN, or **DIHYDRO-SULPHURETTED SULPHOCYANOGEN**, is obtained from sulphocarbonate of ammonium by the action of chlorine. It is a colourless crystalline powder, is soluble in alcohol and ether, but insoluble in water. Alcoholic potash decomposes it into sulphur, potassium sulphide, and sulphocyanate. The formula is $C_2H_4N_2S_4$.

HY'DRATES are compounds containing hydrogen and oxygen in the form of water, as hydrate of sodium (Na_2O,H_2O), which is a hydrated oxide of the metal sodium. The hydrates of sodium and potassium retain the elements of water at the highest temperatures; but the hydrates of the metals generally—as, for instance, hydrate of copper—give up the water when moderately heated; those of the alkaline earths, as hydrate of calcium or lime, require a red heat. The alkaline hydrates are soluble in water, those of the alkaline earths slightly soluble, and those of the metals mostly insoluble.

Many crystalline salts contain a considerable amount of water of crystallization, as the sulphates of magnesium and zinc, each containing seven equivalents of combined water, the alums containing twelve equivalents, and many others; this water is easily driven off by gently heating.

HYDRAULIC ENGINE, HYDRAULIC PRESS, &c. See HYDRAULICS.

HYDRAULIC LIMESTONE is the rather absurd name applied to an argillaceous or magnesian limestone [see DOLOMITE] which, when burnt, produces a lime or cement that sets under water.

The "hydraulic" properties are dependent on the percentage of clay and silicate contained in the lime. *Hydraulic limes* contain from 10 to 30 per cent. of clay; they slake and harden slowly under water. *Hydraulic cements* contain from 40 to 60 per cent. of clay; they do not slake, but harden rapidly under water. Natural hydraulic limes are mostly obtained from the *septaria nodules* of the London, Oxford, and Kimmeridge clays; but these have been largely superseded by the cements obtained on calcining the calcareous mud of certain rivers, as the Thames, Medway, &c.

HYDRAULIC ORGAN (*Hydraulica* or *Hydraulis*) was an ancient instrument of the organ character, differing from our organ only in the principle of the wind supply. In the organs of the present day we force wind into a bellows-chamber which has a weighted top; pressed down by this heavy top the wind is forced out into the great wind trunks which supply the organ pipes. In the hydraulic organ, an invention of Ctesibius, a celebrated philosopher of Alexandria, about B.C. 250, water is used as the storage medium. By means of a piston air was driven into a cylinder which stood in a tank of water until the air became sufficiently compressed to drive the water before it, but as the water, pressed upon by the outside water in the tank, was constantly seeking to regain its normal level in the cylinder, it would exert a great compressing force reacting upon the air, and the pressure on the air once obtained would remain unaltered. Should air be forced in beyond the total content of the cylinder, it would simply escape into the tank and rise in bubbles to the surface. In this ingenious way was the intermittent wind supply from the alternating strokes of the piston converted into a steady and uniform pressure of wind into the wind trunks which opened into the cylinder and conveyed the wind to the pipes. But as outside observers saw merely that water sometimes bubbled up in a large open vessel and was perpetually rising and falling (as the water pursued the air into the cylinder or was driven back by it), they coupled this with the stroke of the piston, and concluded that water was being pumped into the organ; and the instrument was named *hydraulis*, or sometimes *hydraulikon organon*.

Tertullian (second century), one of the early fathers of the church, compares the soul of man to the hydraulic organ. As the soul of man animates the whole body so does the wind fill and inspire the whole organ. "Behold," he cries, "the magnificent bequest of Archimedes, I mean the hydraulic organ." (Everything mechanical was blindly set down to Archimedes.) "So many members of that body, so many parts, so many joints, so many channels for utterance, such union of different sounds, such interchanges between time, measure, and mode, and so many rows of pipes; yet all form together but one huge pile. So the breath which then pants by the tossing about of the water, will not be separated into parts because it is administered through parts; it remains entire in essence though divided in its working." ("De Animâ," cap. xiv.)

HYDRAU'LICS. This term is applied to the art of constructing machines in which water is employed as a moving power, or by which that fluid is put in motion; and it necessarily includes the principles by which such machines are executed. In fact, hydraulics is the practical outcome of hydromechanics, depending partly upon the principles of the equilibrium of liquids [see HYDROSTATICS], and partly upon the force of moving water [see HYDRODYNAMICS]. But the term is of wide application, and may in ordinary language be applied to any construction involving hydrous considerations.

Hydraulic architecture or engineering is the art of constructing docks, quays, or any building whose foundations are laid under water. No country in Europe possesses more advantages with respect to naval power than Great Britain and Ireland. The islands and headlands on their coasts form excellent natural ports; and these, where necessary, have been converted into secure harbours by every means which the science of the hydraulic engineer could devise. The breakwaters at Plymouth and Portland, the lighthouses which have been raised in the ocean, and the vast docks at the principal seaport towns, are so many practical examples which render the British Isles a complete school for the study, in detail, of every subject connected with this branch of science.

Hydraulic engineering now chiefly involves the construction of masses of masonry whose foundations are laid in the beds of rivers or in that of the sea, such as the piers of bridges, quays, jetties, and breakwaters; also the formation of artificial harbours and docks for shipping, and locks at the falls on rivers or canals. In all these cases great precautions are requisite to secure the foundations and give the superstructure sufficient strength to resist the pressure of water which may find its way under or behind, and cause the destruction of the works. The starlings of the old bridges at London and Rochester were examples of the rude methods anciently employed in this country for building in water. Caissons resting on piles driven deep into the ground under the intended work are occasionally employed when the water is not very deep and the soil good. But no work of magnitude can be considered as secure whose foundations are not laid by the engineer in the bed of the water; for this purpose the part on which the construction is to be raised should, if possible, be laid dry by inclosing it within a coffer-dam, and actually drawing off the water by engines.

Since in storms the sea is driven with violence against any object before it, the stability of a wall or breakwater seems to require that its sea-face should have a certain slope. In very deep water probably the best method of forming an embankment is to allow large blocks of stone, with small fragments intermingled, to descend by gravity into the water, as in the construction of the breakwaters at Plymouth and Portland.

HYDRAULIC MACHINES.—Machinery of some kind for the purpose of raising water in order to drain lakes or marshes appears to have been introduced into Egypt at a very remote period, and the hydraulic machines described

by Vitruvius in the tenth book of his "Architecture" are sufficiently simple to allow the supposition that they had been invented at a very early epoch. That writer mentions a wheel with buckets, which took up water from a reservoir on the ascending side of the wheel and discharged it on the opposite side, in consequence of the reversion of their position. He, moreover, notices a species of chain-pump and the spiral machine or "screw" of Archimedes. All these were intended for the same purposes, and were turned either by the impulse of a stream in which they were placed, or by men walking upon them—that is, probably, on the exterior circumferences of the wheels attached to the axles of the machines. Water-wheels for grinding corn are also described by Vitruvius; and lastly, the same writer gives a brief and obscure account of the HYDRAULIC ORGAN.

Since those days hydraulic machinery has been brought to the state which it has now reached by many successive improvements. It may be remarked, however, that on account of the high degree of perfection which within a few years past the steam-engine has attained, the employment of hydraulic machines for raising great quantities of water, or as first-motors with respect to extensive works of any kind, has of late considerably diminished. Yet where the circumstances are favourable, as when a supply of water for working the machine can be readily obtained, the latter, from being less expensive in their maintenance, are still preferred to the former.

The principal hydraulic machines which are in use for domestic or general purposes are of two kinds: those for raising or moving water, as the siphon, the screw of Archimedes, the hydraulic ram, and the various kinds of pumps; and those which use water as a motive power or a means of transmitting power, as the hydraulic press, the hydraulic engine, and wheels turned by water.

Siphon (a Greek word), a bent tube whose arms are of unequal length, and by which a liquid can be decanted from one vessel to another without inverting or disturbing the one from which it is withdrawn. The shorter of the arms being immersed in the liquid which is to be drawn from a vessel or a reservoir, and the air being removed from the tube by suction or by means of a syringe, the liquid immediately rises in the immersed arm in consequence of the pressure of the atmosphere on the water outside the tube; it then passes up to the bend, driven by the unceasing pressure behind, and then, aided by gravity, it flows through the open orifice at the lower extremity of the other arm. This machine was probably invented in the second century B.C., by Heron of Alexandria, who in the "Spiritalia," or Pneumatics, mentions its employment for the purpose of conveying water from one valley to another over the intervening ground. The flow is continuous because the pressure of water up the short arm is continuous; and there is nothing to resist it, since the water in the long arm is perpetually falling away (by gravity) from before it.

The *Ram Siphon* is an application of the siphon to raising water by its own weight. In fig. 1, Plate I., A is the intake of the siphon, A L C the shorter arm, C R the longer arm. It follows from the description of the siphon given above, that if an aperture be made at the bend of any siphon the siphonous flow ceases, for the long arm is speedily emptied by gravity; and the rising of the water in the short arm, pressed upon by the outside water, because that in its turn is pressed upon by the air, is now opposed by the pressure of the air which enters at the orifice and passes up the long arm of the tube when this is empty. This pressure from before exactly neutralizes the pressure from behind, and the flow of course ceases. But in the ram siphon matters are so arranged that the water shall issue from the top of the bend without stopping the flow. It is accomplished in the following ingenious manner:—The valve at the outflow R is arranged to shut upwards when the pressure on it goes beyond a certain amount. It is so weighted that at first, to establish the siphonous flow, it shall remain open, but when the flow becomes rapid R closes. The pressure of water, unable otherwise to relieve itself, pushes up a valve at C, and fills or partly fills the chamber E; but in so doing it relieves the pressure on R, which opening, the regular flow recommences. At this moment C closes, retaining the water in the chamber E. A few alternations of this kind fill the chamber E to such a point that the air is seriously compressed. Now M is a pipe which descends nearly to the bottom of the chamber E; therefore, on the principle of Heron's fountain [see HERON] a jet of water is thrown out of the pipe M by the compressed air; and since the alternate closing and opening of the valves R and C keep up an intermittent supply of water to the chamber E, the flow through M will be continuous, though not very even.

The *Hydraulic Ram* is another machine by which a portion of water in motion raises another portion by its momentum, as shown in fig. 2, Plate I. The current of water (descending from some height, as from an elevated reservoir, &c.) flows strongly in the direction of the arrow; acquiring a certain force, it closes the large ball valve B, and at the same time forces open the small ascension valve A, and relieves itself of pressure by rushing into the cistern G. But the pressure being relieved the ball B again drops and allows the water to run to waste, till the flow once more acquires velocity enough to close the valve, when the previous chain of results again ensues. But the water in G, as with the ram siphon previously described, compresses the air in G, which returning the pressure from its own elasticity forces the water up the tube H. The amount of work done in proportion to the force expended in this machine is computed at 45 per cent.

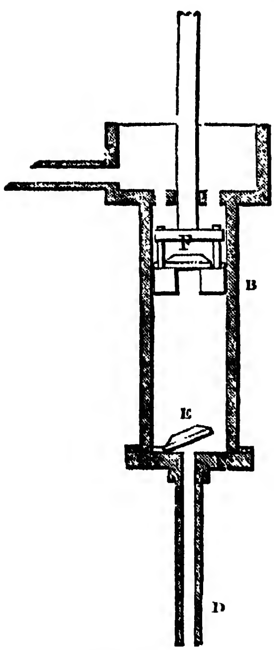
Screw of Archimedes.—In Plate II. (figs. 4, 5) the two usual forms of this machine are shown. It is either a tube or an inclined plane coiled spirally round a core. The latter form has usually a tight jacket or case, turning therefore with the screw; but in a German form the case is loose, and the screw turns within it. This leads to much leakage, usually at least one-third. The principle of the screw of Archimedes is obvious. The whole machine is tilted until half of any one spiral turn shows an angle below the horizontal line and the other above it. As the screw turns the water falls by gravity, but as it keeps on turning the screw perpetually brings beneath the water what is relatively to the water a lower level, but is really a point higher up the tube. It is a special case of the inclined plane. The German form, indeed, is very little other than an inclined plane which pushes the water continually before it—wedging it onwards, so to speak.

The demerits of the screw of Archimedes are (1) the long path of the water as against vertical lifting, and (2) the great weight and friction of the instrument arising from the weight of water it carries, all of which has to be moved at each revolution, though only one-twentieth or thereabouts is delivered. Another machine on a similar principle (the spiral pump of Wirtz) will be described later on under the section on *Pumps.*

Multiplying-wheel Bucket-engine.—This is a machine the theory of which was worked out in the sixteenth century, but the first man actually to erect one was Geronimo Finugio at Rome in 1616. It is shown in fig. 6. The object is to raise water from a well, A, to a reservoir, R. The wheel, W, is 6 feet in diameter, but the smaller and concentric wheel is 2 feet only. Round the large wheel, W, runs a chain, W x, suspending the bucket, b, in the manner indicated in the small figure (fig. 7). Round the small wheel, w, runs the chain, $w\ y$, fastened to a rod, $y\ z$, suspending a large bucket, B, in the manner shown in the other small figure. Both buckets have a valve at bottom.

Now, let the bucket *b* be full of water; then, when the bucket B is also filled, it will descend and raise the smaller bucket, because B is much the heavier of the two. But as *b* touches the hook *s* it is tilted (fig. 7), and discharges its water into the reservoir R, and at the same moment the lever *m*, operating on the valve in B (as shown in fig. 7), touches the hook M, in the side of the waste pipe, and B is discharged of its load. But now that both are empty, since *b* hangs from the great wheel, it is able by its greater leverage to drag up B, which hangs from the small wheel, and *b* descends into the spring, while B ascends to the outlet. Each now fills; *b* by its valve yielding to the pressure of the water beneath, B by catching the stem of the valve *a* in the outlet and raising it. The water pours into B until it is heavy enough to raise *b* (now loaded also) as before, and so the process continues automatically. One hogshead of water falling 10 feet will by this machine raise very nearly one hogshead 10 feet. Q is a quadrant turning on the centre C, and bearing a weight, X. This descending (by the rackwork, *c d*) at the same time as B descends, the weight, X, swings across to the position P, and so diminishes the weight on the bucket B. The object is to counterbalance the *increase* of weight which would otherwise occur by the lengthening of the chain to which B is attached.

Pumps.—The common pump is a machine for raising water by the pressure of the atmosphere; it consists of a cylindrical body or barrel, A B, from the lower part of which a tube, D, descends into the water contained in the well or reservoir. In the interior of the cylinder is a movable piston, F, surrounded with leather in order that it may be water-tight, yet capable of moving up and down with freedom. The piston is perforated, and the orifice is covered above by a valve which opens upwards; a similar valve, E, at the bottom of the cylinder or barrel covers the upper extremity of the tube which leads to the well.



Common Pump.

The piston being raised by means of the handle, the air contained in the tube D tends by its elasticity to occupy the lower part of the cylinder, which it enters by forcing up the valve E; and its elasticity diminishes in consequence of its occupying a greater space than before. Hence the air exerts on the surface of the water within the tube, at D, less pressure than that which the external air exerts upon the water in the well; and the water consequently rises in the tube to a certain height. The valve E then falls over the orifice, and the piston being depressed, the air contained between it and the bottom of the cylinder will be condensed; in which state it will force up the valve F and escape at the top of the pump. The valve F then falls; and if the piston be again elevated, the water will rise higher in the tube D, for the same reason as before. The operation of raising and depressing the piston being repeated a few times, the water will at length enter into the cylinder through the valves E and F; after which it will at each stroke of the piston be driven through the spout. Since the column of water in the pump is supported by the pressure of the atmosphere on the water in the well, it is evident that the greatest height of the piston above the surface of that water can never exceed 33 feet; for this is the height of a column of water which exactly balances (or is of equal weight with) a column of air of the same diameter, and extending upwards through the entire atmosphere. A column of mercury is much heavier; about 30 inches high of mercury is all that the atmosphere will balance.

That which is called a *Lifting-pump* is frequently similar in construction to the common pump above described; but the lower valve, E, is always below the surface of the water in the reservoir, and so also the piston F when depressed to the bottom of the cylinder or barrel. On raising the piston the water above it is lifted up, and the pressure of the external atmosphere forces the water of the reservoir to enter into the cylinder through the valve E. Then, by successive depressions and elevations of the piston, the water is at length raised to the top of the pump, and discharged by the spout.

The *Forcing-pump* (fig. 3, Plate I.) is one in which the water, when raised in the barrel G H, is driven through an orifice in its side by the depression of the piston P, which is solid or without a perforation; consequently when the piston descends the water is compressed between the piston and the valve E, which it shuts, and it escapes through the valve F into the side pipe Q R, with a force proportionate to the momentum of the descending piston. It is also in general provided with an air-vessel, into which the water is forced, and whence, by the elasticity of the condensed air, it is made to issue steadily through a pipe inserted in the upper extremity. For an example of converting unsteady motion into steady motion in exactly the converse way, see HYDRAULIC ORGAN.

Chain-pump.—For raising water from great depths and in large quantities, chain-pumps, as they are called, have been frequently employed. In this machine a chain, carrying a number of flat circular pistons, passes round a wheel at the upper, and sometimes also at the lower extremity, each piston as it goes over the wheels being in part received in the intervals between the radii. The wheel being put in motion, the pistons descend and enter from below into a barrel on the ascending side, when, pushing the water before them, they raise it into the reservoir, from whence it escapes by a pipe. Machines of this kind are frequently fixed in inclined positions; and it is when the inclination of the barrel is about 24½ degrees, the distance of the pistons from one another being equal to their diameter, that the greatest quantity of water is raised.

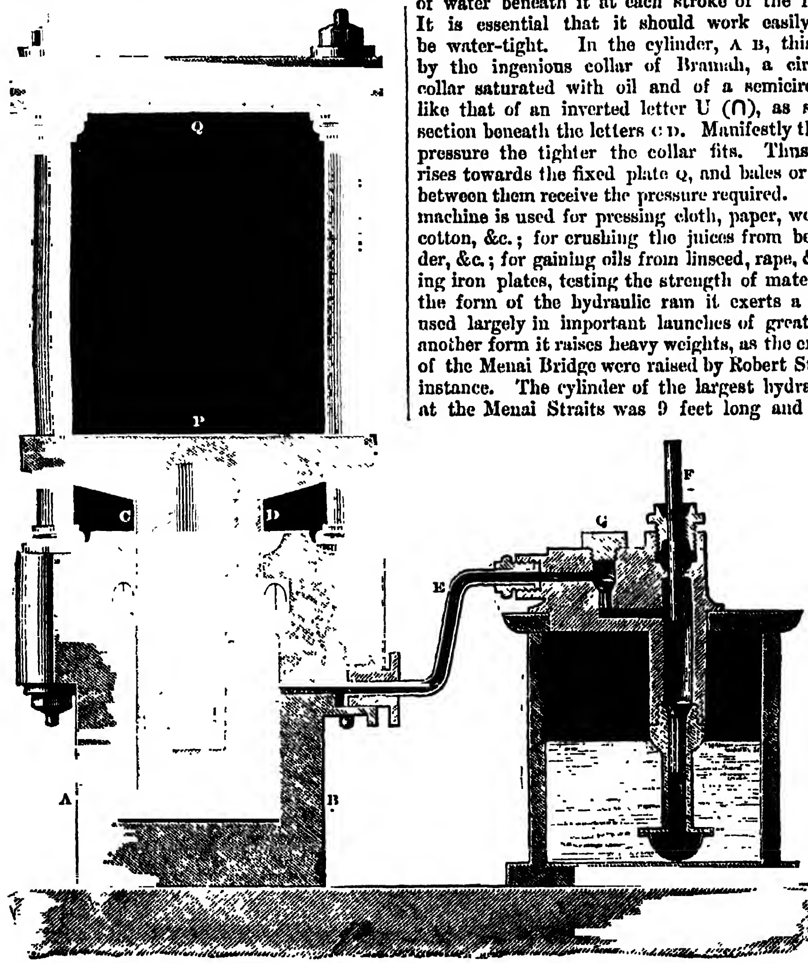
Another form of chain-pump is an endless series of buckets, shown at *s s s* in figs. 8 and 9, Plate II. The principle is the same as before, there being no essential difference between these buckets and the pistons of the chain-pump proper.

Another improperly named pump is the so-called *Spiral-pump* of Wirtz (otherwise known as the *Zurich Machine*), invented by Wirtz at Zurich in 1746. It is shown in fig. 10. Here the large spoon or opening of the spiral takes in about equal quantities of air and water alternately, and the elasticity of the masses of air which thus divide the masses of water in the machine, intensified by the compression occasioned by the latter, powerfully assists its onward passage, and helps to support the weight of the column of water (divided by layers of air) in the ascending delivery pipe. For raising moderate quantities of water to small heights the machine serves well; but if greater heights are attempted the coils of the spiral must be increased in number, and it becomes heavy to

work. Dr. Young demonstrated with it at the Royal Institution to the height of 40 feet.

Hydraulic Press.—The hydraulic press was invented by Bramah, and is a machine of very great power in compressing bodies or lifting weights; or, again, in drawing up trees by the roots, or piles from the beds of rivers. The annexed engraving gives in section the general details of the hydraulic press.

A B is an iron cylinder in which works the piston, C D. Let E be a small tube opening into the vessel A B, and having a valve opening inwards. Let the cavity of A B be filled with water, as also a part of the small tube E; the pressure of a single pound applied at F to the piston-rod will produce a pressure upon C D which will be to the former as the area of the end of the piston C D to that of the piston F in the forcing-pump.



Hydraulic Press.

If we suppose the diameter of the former to be 10 inches, and that of the piston in the forcing-pump to be a quarter of an inch, then the proportion between the surfaces of the pistons will be that of 1600 to 1; and on the principle of the equal pressure of fluids in every direction, the force with which the piston C D is raised is to the resistance against the lower surface of that in the forcing-pump in the same proportion.

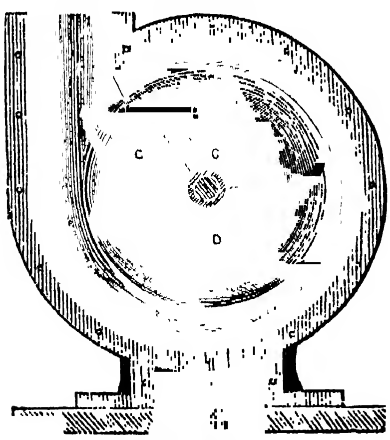
The action of the press is as follows:—The piston of a small forcing-pump is shown at F. When this piston ascends the water rises from the cistern into the tube of the pump, shown in section, a rose being fitted to the lower end of the tube to prevent extraneous matters from being drawn into the pump. When the piston F descends it closes the valve of the tube, shown in the section, and compresses the water strongly against it. The water, therefore, escapes by the tube E, and is forced into the cylinder A B. But when the piston F rises again for the next stroke and the pressure is momentarily relaxed, the water cannot return because of the valve, shown just under letter G in the section. The piston, C D, rises with irresistible force, pressed upwards by the growing mass of water beneath it at each stroke of the forcing-pump. It is essential that it should work easily, but should be water-tight. In the cylinder, A B, this is obtained by the ingenious collar of Bramah, a circular leather collar saturated with oil and of a semicircular section, like that of an inverted letter U (∩), as shown in the section beneath the letters C D. Manifestly the greater the pressure the tighter the collar fits. Thus the plate P rises towards the fixed plate Q, and bales or goods placed between them receive the pressure required. This powerful machine is used for pressing cloth, paper, wool, hops, hay, cotton, &c.; for crushing the juices from beet-root, madder, &c.; for gaining oils from linseed, rape, &c.; for bending iron plates, testing the strength of materials, &c. In the form of the hydraulic ram it exerts a driving force, used largely in important launches of great ships; or in another form it raises heavy weights, as the enormous tubes of the Menai Bridge were raised by Robert Stephenson, for instance. The cylinder of the largest hydraulic ram used at the Menai Straits was 9 feet long and 22 inches in internal diameter; it was capable of raising a weight of 2000 tons.

Hydraulic Cranes, &c.—Another application of the same principle is to the working of powerful cranes and lifts, or to any machinery required intermittently, as the opening of dock-gates and the like. Here the plate P (in the hydraulic press) is weighted with very heavy weights, and from the cylinder, A B, proceed numerous small pipes to the various parts of the building where the power is to be applied. The cylinder is then filled by the forcing-pump in the usual manner. When power is wanted the plate P, now enormously heavy, crushes down the piston,

C D, upon the water in A B, and drives it with great force through whichever of the smaller pipes has been opened into the suitably constructed machine, which is situated at the point desired. Suppose the area of the piston, C D, is 4 square feet, and the load of the plate P is 100 tons, the pressure on the water in A B would be 388·8′ lbs. to the square inch, and it is obvious that by suitably proportioning the area of the pistons used in the hydraulic machines any required power within these limits can be obtained.

A modification of the hydraulic press is very successfully used in the manufacture of seamless tubes from block tin or lead. The plunger of the hydraulic press descends into a cavity which it nearly fills, a thin space being left all round between the plunger and the circumference of the cavity of the thickness of the intended tube. The metal is put into the cavity as a little disc. The plunger squeezing this with irresistible force, it runs up the side of the plunger in a most extraordinary manner, and when the plunger rises again the finished tube, perfectly smooth and polished by the pressure, is slipped from off it. Such articles as artists' oil colours, perfumery, &c., are put up in these tubes.

The *Centrifugal Pump* is a development of the principle often employed in fans for creating currents of air. A section showing the principle upon which such machines are constructed is here given. The apparatus consists of a cylindrical casing, within which a propellor, B G, rotates, bearing blades of a suitable curve. The water enters through the middle of the casing, at C in the figure, is



Centrifugal Pump.

caught by the blades, whirled round, and flies off tangentially by the centrifugal force it acquires along the outlet, F. A partial vacuum being thus created in the feed-pipe, A, the supply of water is kept up by the effects of atmospheric pressure, as in the common pump.

Water Wheels.—Water may be made to act as a moving power against wheels by its weight, its momentum, or by both combined. In the first case the wheel is provided with a number of buckets or troughs, into which the water is received near the level of the axle of the wheel; the vessels thus filled becoming heavier than those on the other side, the wheel is made to revolve by that excess of weight merely. But if the water fall into the troughs from a channel on a level with the top of the wheel, or at least above the axle, the wheel will revolve both by the weight and by the momentum which the water acquires by its fall. This is called an *overshot* wheel. (See Plate III., fig. 11.) Again, if the lower part of the wheel be placed in a stream of water which is made to act on float-boards fixed on the circumference, the machine receives the name of an *undershot* wheel (figs. 12 and 13). Lastly, when the wheel is placed in a sort of channel or *race*, as it is called, which is formed between two projections of masonry below the bed of the upper portion of the stream, and so as to coincide very nearly with the lower quadrant of the wheel's circumference on that side, the water descending from the stream upon float-boards or troughs, and thus acting both by its momentum and weight, the machine is called a *breast*-wheel (fig. 14). The breast-wheel unites in some measure the advantages of both the others.

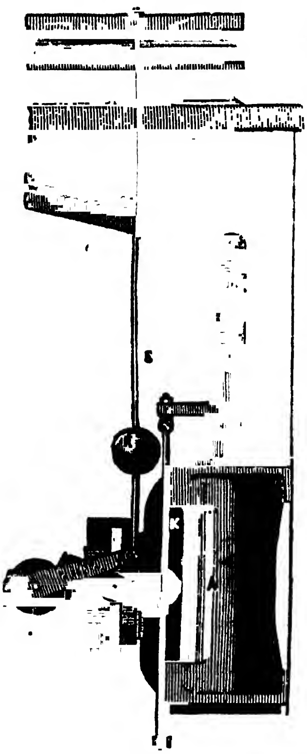
Many contrivances have been adopted for enabling the troughs of an overshot wheel to retain, during their descent, as much as possible of the water which, by entering into them, causes the wheel to revolve; as, for instance, making the side of each trough with three boards parallel to the axle of the wheel, that which is nearest to the *sole* or convex surface of the wheel having its breadth in the direction of the radii and equal to half the interval between the troughs, which is usually about one-fortieth of the circumference of the wheel, and the two other boards making a very obtuse angle with one another, the upper edge of the third being rather above the lowest board in the next higher trough. Smeaton considered that in small works the rim of an overshot wheel should have a velocity of about 3 feet per second only; but in large works it may be greater. He estimates the greatest quantity of work performed at about two-thirds of the power expended. Weight of water aperture, and diameter being similar, the power of an overshot wheel exceeds that of an undershot as 13 to 5 nearly. The greatest effect is got from an overshot wheel when the diameter of the wheel is two-thirds the height of the water above the lowest point of the wheel.

The theory of undershot wheels is very imperfectly known; but it seems, from the experiments of De Parcieux and Bossut, that a sensible advantage is gained by inclining the float-boards to the produced radii of the wheel at an angle of about 20 degrees, each board when at the lowest place having its edge turned towards the upper part of the stream. Such inclination will cause the water to accumulate along the float, and thus act by its weight as well as its pressure; the floats should consequently be rather broader than the depth of the current of water which they intercept. If a stream of water, B A (see Plate III., fig. 13), impinge on the float-boards of an undershot wheel, W H, and escape from it the very instant after it has made its impact at E F C the quantity of water which actually impinges will be to the whole quantity which passes by it in a given time as the difference between the velocities of the water and wheel to the absolute velocity of the water. All the water does not touch the wheel—for observe the section D K. When the float F has arrived at C, let D K, which moves faster than the wheel, occupy the position F C, it has therefore no effect on the float F, which is now emerging, nor has it any on the float E, which it has already passed. If the velocity of the water be unaltered, the effect will vary as the quantity of water expended. It has been determined by experiment that the effect of the wheel is the greatest when its velocity is about half the velocity of the stream.

A *horizontal* wheel differs in no respect from an *undershot*, except in its being placed horizontally instead of vertically. Horizontal water-wheels as such are, however, not now used. They have developed into the *turbine*, a horizontal wheel which is entirely submerged at the base of the column of water supplying it, though some varieties act equally well in any part of the column, provided they have an escape pipe entirely filled by the falling water. The most important advantage of turbines over the older forms of wheels is their greater velocity, which is due to their generally smaller size. One form of turbine is shown in figs. 15 and 16, the former being a plan and the latter a section of Fourneyron's turbine. It consists of a fixed central cylinder, *a a*, which forms the inlet pipe. It is

closed at the bottom, but has an annular opening extending round its entire circumference, by which the water can escape laterally, and its direction is governed by a series of curved partitions or guides, shown in the plan. The wheel *b b* surrounds this opening. Its buckets consist of a series of partitions curved in the reverse direction to the guides, so as to catch the water as it leaves the latter. After setting the wheel, which turns on the pivot *c*, in motion, the water makes its escape by the openings in its circumference, its reaction, as in BARKER'S MILL, tending to aid the rotation. This turbine is frequently worked under the surface of the escaping water, in order to utilize the entire available fall, and it has a contrivance by which the amount of water used, and consequently the power of the turbine, can be regulated. This, as shown in fig. 16, consists of a sliding portion of the cylinder *a a*, which can be raised and lowered from above, thus increasing or diminishing the aperture by which water is supplied to the wheel *b b*. The vertical axis *d* rises through a tube in the cylinder and communicates the motion of the wheel to suitable gearing. Various forms of turbine exist, differing chiefly in the mode in which water is supplied to the wheel. A good turbine will utilize from 75 to 88 per cent. of the power of the water-flow. In the best forms of overshot and breast-wheels 65 to 75 per cent. is utilized, and in undershot wheels only 25 to 33 per cent.

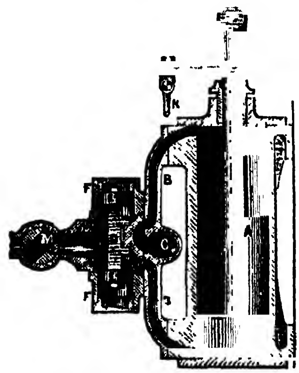
Hydraulic Engine.—There are as many forms of the water-engine as of the stationary steam-engine. Hydraulic locomotives, from the nature of the case, are manifestly impossible. All hydraulic engines rest on the same fundamental principle. We may take any one for an example; for instance, the useful little engine used for driving organ bellows and small machines, as sewing machines, folding machines &c. A is the cylinder, with ports the same as in a steam-engine cylinder, B being the inlet ports and C the exhaust. D is a common slide valve, working over the face of these ports, and moved by its attachment to a small double piston, E, working in two small cylinders, F, in the ends of the valve box, G. H is the water main. The pistons, E, are moved by the water pressure, which is let into and out of their cylinders alternately by a small four-way cock, I (in Plan); this cock is moved by a lever, J, and a rod, K, which is attached to an arm on the piston rod; the rod is fitted with set nuts or tappets for adjusting the action of the four-way cock. In the outlet port of the four-way cock is a set screw, L, by which the area of the passage of that port can be diminished, and the water retarded to any desired extent in its escape from the cylinders, F, and thus the motion of the valve, D, regulated. O is the attachment to the feeder.



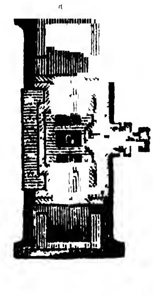
Hydraulic Engine used as an Organ Blower—Side Elevation, showing the attachment to Bellows.

On the water main, H, is a large ordinary stopcock, M, to which is attached a lever, N, and rod, S, connected to the reservoir of wind, P, supplied by the bellows, at such a position that when the reservoir collapses by the exhaustion of the air, the cock, M, is opened by the weight, R, and the engine is set in motion, at once sending more wind into the reservoir.

The illustrations show in various sections the normal position of the engine when the water is turned on and the wind reservoir full of wind; the engine then moves

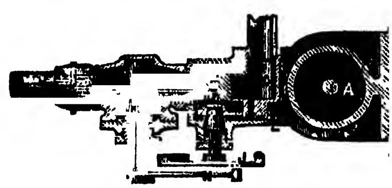


Vertical Section through the Cylinder.



Vertical Section through the Valve Chest.

only at an extremely slow speed, sufficient to supply the leakage of wind through the material of the wind reservoir. The moment wind is abstracted from the reservoir, its depression opens the cock, M, and the engine is set in motion with a speed proportioned to the amount of the exhaustion. Thus the supply of wind is always in exact proportion to



Sectional Plan.

the demand, and overblowing and unsteadiness, as in hand blowing, are entirely prevented.

Hydraulic Clock or *Clepsydra.*—In the article CLEPSYDRA the measurement of time by the dripping of water from a graduated jar is spoken of. But later times saw much more accurate *clepsydræ*, some of which were really elaborate pieces of mechanism. In Plate IV. some varieties of these hydraulic clocks are given, so that a brief description of the figures will be all that is necessary. Fig. 17 is the ancient Greek clepsydra as improved by Ctesibius of Alexandria. A is the reservoir, kept continually supplied. From A the water passes by the tube B to the drum M N. Concentric with M N is the inner movable drum, O D L, resting on the hollow spindle F, which turns in the hole G. The inner drum is drawn forward in the figure to show the groove *a b*, which is observed to be tapering; in its present position it is much wider at the top than the bottom. The water passes from M N, through an aperture at the top, into the inner drum O D L; but as the apertures of the latter vary in size with the varying width of the groove *a b*, the quantity of

water admitted to O D L varies. When the sun is in Capricorn and the days are long, O D L is turned on its axis till the day index, L, points to Capricorn; this brings the largest of all the twelve apertures beneath the orifice in M N, and much water is admitted during the days of that month. The water, its flow being thus regulated, passes from O D L through F and through G into a pipe which discharges itself into H by the conduit, X. The level of the water in H, as it rises, carries up with it the float, I, and this permits the spindle, P, to be turned round by the pull of the weight, K. The spindle, P, carries the hand of the clock. Once a month the drum, O D L, must be turned, and the day index made to point to the proper zodiacal sign; the length of the hour during the day then alters, and remains at its new length throughout the month. Every day at sunset the night index, O, must be brought round to the sign of the month, thus exactly reversing the flow, short day-hours necessitating long night-hours, and *vice versâ*; and every morning at sunrise the day index must be set at its proper place again. Thus day and night are each divided equally into twelve hours, according to the Egyptian method of reckoning time.

A more modern arrangement is shown in fig. 18. Here a drum, E, turns on its own axis, *a b*, and thus unwinds the cords, A *a*, B *b*. The ends of the axis point to the hours marked on the frame. A simple arrangement of a reversed coil, with a bucket used as a counterweight, F, easily renders it possible to regulate the speed of the clock. It is easy also to show the hour on a dial at the top of the frame by a cord, *c d*, wound round the spindle of the dial and pulled by the counterweight, F. The cause of the slow rotation of the drum is shown by the section at fig. 19; N gives the line of the supporting cords, which are simply wound round the axis, and not fastened to it. It might be supposed that the drum thus being supported by cords, always necessarily on one side of its centre of gravity, would rapidly run round and descend. But the inside of the drum, as shown, is partially divided into compartments by the partitions G *g*, H *h*, &c., all tangential to the small dotted circle in the middle. A certain quantity of distilled water is introduced and the drum closed. The water tries to fall, but can only pass gradually from one compartment to the next by a very small aperture, as at K I, &c. The drum therefore rotates slowly from left to right as the water leaves K I, and passing into I H drags it down by the force of gravity, and so trickles on into H G, &c. Simply rotating the drum by hand in the opposite direction winds up the clock and coils the cords, A *a*, B *b*, thus bringing the drum up to the beginning of a new career. In this form the twenty-four hours of day and night are all made equal to each other.

Hamilton's Clepsydra, described by its inventor, the Honourable Charles Hamilton, in vol. xliv. of the *Philosophical Transactions* of the Royal Society, is an exceedingly ingenious piece of mechanism, acting by five siphons and two balances. The upper part of the case is shown in the plate at fig. 20, but the lower part of the case is removed that the mechanism may be seen. A long siphon, J, brings water from a reservoir into the trough, *s t*, which oscillates on the centre, K, in the manner of a *hydraulic pendulum*. Hence the water flows into either A B or C D, according to the direction in which *s t* is sloping at the time. A B and C D are cylinders fastened to the case. Let the water be flowing into A B, as in the figure, it will rise and bring up the column of wood, *a b*, with it, so that the chain, *f*, is dragged round the pulley, *h*, by the counterpoise F, and the barrel *i* turns, carrying the hands of the dial with it. But soon the water will rise so high as to fill the short arm of the siphon, *l*, which dips down into A B. The siphonous flow will at once begin, and A B will be speedily emptied, the water passing into the bucket *n* (just as in the figure C D is being emptied by its siphon, *m*, into the bucket *o*). But this will cause the bucket, *n*, to grow heavy and therefore to fall, for it is fixed on one arm of a balance poised at *p*. In falling, *n* pulls the cord *x* attached to it, which, passing upwards and round a pulley to the trough *s t*, consequently causes the end *s* of that trough to be raised, and the end *t* to be depressed. This therefore diverts the flow of water into the cylinder C D, and the wooden column, *c d*, begins to rise. The vessels *n* and *o* are emptied from time to time by the small siphons *q* and *r*, which begin to act directly the water in the vessel rises level with their bend. The vessel *n*, thus emptied, is shown in the figure as being raised by its fellow, *o*, which has become sufficiently heavy to outweigh it. Each half of the apparatus carries on the work by turns, and two ratchet-wheels, one of which is shown at *h*, provide that all the work shall tell only in one direction; for when the pulleys reverse their motion to allow one of the wooden columns, *a c*, to descend into the cylinder A B or C D, as the case may be, their corresponding catch slides harmlessly over its ratchet on the barrel.

HY'DRIDES are compounds of metals, alcohol, or organic acid radicles with hydrogen, as hydride of copper (Cu_2H), hydride of methyl or marsh gas (CH_3H), hydride of phenyl or benzene (C_6H_5H).

HYDRIOD'IC or **IODHY'DRIC ACID.** See IODINE.

HYDROBEN'ZAMIDE, or **TRIBEN'ZYLENE DIAMIDE,** is obtained by the action of ammonia on bitter almond oil or hydride of benzoyl. When these liquids are left in contact in the cold for several days this substance crystallizes out in fine crystals, which melt at 110° C. (230° Fahr.) The formula is $C_{21}H_{18}N_2$. It is soluble in alcohol and ether, but insoluble in water. It is inflammable, burning with an odour of almonds. With chlorine it forms a chloride of hydrobenzamide, which is a yellow liquid having the formula $C_{21}H_{18}N_2Cl_2$. It is decomposed by water; by heating to 180° C. (356° Fahr.) it forms chloro-hydrobenzamide ($C_{21}H_{17}ClN_2$), a colourless heavy liquid, also decomposed by water.

HYDROBER'BERINE is obtained by the action of hydrogen on berberine. It is a base, crystallizing from alcohol in colourless needles, and has the formula of berberine with two atoms of hydrogen, $C_{20}H_{21}NO_4$. It forms with acids a number of well-defined crystalline salts, the best known being the sulphates, nitrates, and hydrochlorates.

HYDROBRO'MIC or **BROMHY'DRIC ACID.** See BROMINE.

HYDROCAR'BONS, a very large series of bodies containing hydrogen and carbon only. These compounds occur in great variety in the products of destructive distillation of organic matter, especially in that of coal—the hydrocarbons produced depending on the temperature employed, the paraffin series being obtained at a low temperature, and the benzole and naphthalene series at a high temperature. Some of the hydrocarbons, such as ethylene (C_2H_4), are called olefines, from the property of forming oily liquids with chlorine, bromine, and iodine, as Dutch liquid from ETHYLENE ($C_2H_4Cl_2$). These olefines combine with strong sulphuric acid. Another class are the camphines or terebines, found in many plants, as oil of turpentine ($C_{10}H_{16}$). Some, as acetylene (C_2H_2), have been obtained directly from the elements, and from this hydrocarbon, thus obtained from inorganic materials, Berthollet produced alcohol, and built up step by step many other organic compounds. The hydrocarbons are described under their respective names.

HYDROCARBOXYLIC ACID. Three acids having this name are obtained from carboxide of potassium, the black substance left in the retort in the manufacture of metallic potassium. Treated with hydrochloric acid it yields trihydrocarboxylic acid ($C_{10}H_{10}O_{10}$) in white crystalline needles. If alcohol be present, dihydrocarboxylic acid ($C_{10}H_8O_{10}$) is obtained in black crystalline needles; if access of air be permitted, hydrocarboxylic acid ($C_{10}H_6O_{10}$) is obtained in red crystals. The two former acids are soluble

in water; the latter is decomposed by water, but soluble in alcohol.

HYDROCAR'OTIN is a substance obtained from the common carrot (*Daucus carota*), natural order Umbelliferæ. It is obtained in large colourless crystals. It is soluble in ether and alcohol, but insoluble in water. It melts at 126° C. (259° Fahr.), and combines with chlorine and bromine.

HY'DROCELE (Gr. *hudōr*, water; and *kēlē*, a tumour), a medical term for a swelling produced by a collection of watery fluid in connection with the testicle or spermatic cord. It occurs usually in the shape of an oval or pear-shaped enlargement, which fluctuates when pressed, has a smooth even surface, and is generally neither tender nor painful. It is a chronic disease, and though it occurs at all periods of life it is most common about or beyond middle age. Sometimes it results from acute inflammation, but more often there is no apparent local cause. The treatment of hydrocele is either palliative or radical. Palliative treatment consists in the evacuation of the fluid by tapping, which affords temporary relief, but the swelling usually returns within two or three months after the operation. Radical or curative treatment consists in exciting such active inflammation of the opposite surfaces of the tunica vaginalis as may produce their adhesion and the obliteration of the cavity. This is usually effected by the injection of a stimulating fluid, usually the tincture of iodine, into the sac, an operation which rarely fails to cure the disease.

HYDROCEPH'ALUS (Gr. *hudōr*, water; and *kephalē*, head), water in the head, is a name applied to two distinct diseases nearly peculiar to infancy and childhood, which are distinguished as the acute and the chronic.

Acute Hydrocephalus, or more properly *Tubercular Meningitis*, is a most frequent and fatal disease of the early stages of life. It occurs most commonly between the first and the eighth year. The child is frequently ill for several days before the inflammatory symptoms become evident; it is liable to momentary giddiness while moving quickly, is fretful and nervous, and its rest is disturbed; it loses its appetite, its bowels are costive and the motions offensive. The eyes become heavy, the face pale, the features devoid of animation, and the child complains of heaviness of the head. The symptoms more surely indicative of the disease are more intense pain in the head, to which the child constantly carries its hand; intolerance of light, sound, and motion; disturbed sleep, with grinding of the teeth, the child frequently waking with a scream; the pulse is slow and irregular. The appetite is lost, the evacuations from the bowels are unhealthy, and vomiting ensues. The abdomen, if previously distended, now falls in, and becomes quite flat. Stupor, interrupted by screams, follows. After these symptoms have continued for some hours or days, there will sometimes be a temporary recovery of sense; but this promising state is soon interrupted by convulsions, complete loss of sight and hearing, and inability to swallow; the extremities become cold, and death follows.

The treatment must vary in the different stages of the disease, but will generally consist in endeavouring to subdue inflammatory action, in removing any causes which may, directly or indirectly, keep up irritation of the brain; and lastly, in the later stages, in supporting the strength of the system.

Chronic Hydrocephalus.—The disease to which this name is applied is correctly denominated water in the head, being always accompanied with a considerable collection of watery fluid in the cavity of the head, sometimes within the membranes of the brain only and exterior to the organ itself, but more frequently in the ventricles or cavities of the cerebral hemispheres, which are then distended in the form of a sac. The quantity of fluid is sometimes so great as to cause an increased size of the skull, amounting to great deformity. The disease generally arises before or very soon after birth; and the cranial bones not being completely ossified at the time of its commencement, they become separated to a distance from each other, and the sutures remain open for a long period. When the disease comes on after birth, its early progress is very insidious. In the majority of cases very little can be effected by medical treatment.

HY'DROCHARID'EÆ, a small order of plants inhabiting ditches, lakes, and rivers in various parts of the world. None of the species are of any known use, except the *Vallisneria alternifolia* of India, which is used for the purpose of conveying water mechanically to sugar in the process of refining it.

Hydrocharideæ belongs to the series Microspermæ of the monocotyledons. It is characterized by the following particulars:—The flowers are regular and generally unisexual; the perianth is in two series, the outer calyx-like, and the inner more or less petaloid. The number of the stamens is three, six, or nine, rarely more numerous; the ovary is inferior, one-celled, with three to six parietal placentas, which sometimes meet in the centre of the ovary; the seeds are numerous and very small; the embryo is conformable to the seed.

The chief genera are Vallisneria, Hydrocharis, Stratiotes, Thalassia, and Elodea. The genus ANACHARIS has been lately placed by Bentham and Hooker under Elodea; one species is the water-weed, introduced accidentally from America, which has proved so great a pest in our canals and rivers. *Hydrocharis morsus-ranæ* (the frog-bit) is one of the best plants for cultivation in the fresh-water aquarium. *Stratiotes aloides* (the water-soldier) is like a miniature American aloe in appearance; caution must be exercised in introducing it into ornamental waters, as it increases very rapidly. *Vallisneria spiralis* is remarkable for its spiral flower-stalk, which enables it to accommodate itself to the depth of the stream in which it floats, so as to keep its flowers above the water.

HYDROCHLOR'IC, CHLORHY'DRIC, or **MURIAT'IC ACID.** See CHLORINE.

HYDROCHRYS'AMIDE is obtained from chrysammic acid by the action of a reducing agent. It is a dichroic substance, crystallizing in needles, blue by transmitted and red by reflected light; the vapour given off on heating is violet. It is insoluble in water, and only dissolves slightly in boiling alcohol to a pale blue solution. Sulphuric acid dissolves it, the solution being precipitated by water, which throws it down as a blue precipitate. It dissolves in alkalies and alkaline carbonates with a fine blue colour, and these solutions are precipitated by acids. The formula is $C_7H_6N_2O_3$.

HYDROCIN'NAMIDE or **CINNHY'DRAMIDE** is obtained from hydride of cinnamyle, or oil of cinnamon, by the action of ammonia. It crystallizes in prisms. It is a fusible compound, insoluble in water, but soluble in alcohol and ether. The formula is $C_{27}H_{24}N$.

HYDROCOT'YLE, a genus of plants belonging to the order UMBELLIFERÆ. Upwards of ninety species of plants have been referred to this genus. *Hydrocotyle vulgaris* is a native of Great Britain and throughout nearly the whole of Europe, in marshy, boggy places, and on the margins of rivulets on a peat soil. This plant is commonly called Pennywort, on account of its leaves lying flat on the ground and having the size and form of a piece of money. The notion that it produces disease in animals feeding on it is incorrect; but it occurs in damp places, where animals that feed are likely to be attacked with rot and other diseases. [See LIVER-FLUKE.] *Hydrocotyle asiatica* is a native of India, Java, &c. On the Malabar coast it is used as a remedy for leprosy, and no doubt it is of value in skin diseases, both as an internal and as a local remedy. The

leaves, which are bitter, are toasted by the natives, and given in infusion in fevers.

HYDROCYAN'IC ACID, Prussic Acid, or Cyanide of Hydrogen. This well-known highly poisonous acid is described under the article CYANIDES.

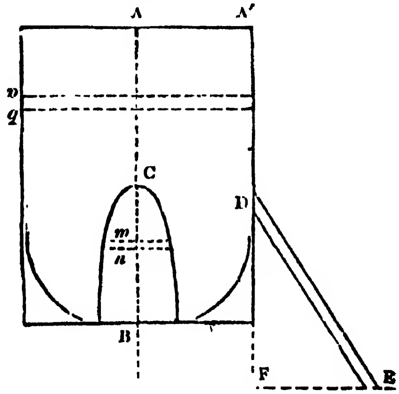
HYDRODYNAM'ICS. Under this word are usually comprehended the conditions of equilibrium and of motion in non-elastic fluids, with the resistances which they oppose to bodies moving in them. The subject consists chiefly in investigating by mathematical reasoning, or in showing from observation and experiment, the laws relating to the discharge of fluids through orifices and tubes in vessels or reservoirs, and to their motions in canals or rivers.

Concerning the laws of the motions of fluids as they were known to the ancients, little can be said; the only notice of this branch of science, even in the time of the Roman Empire, is contained in the treatise "De Aquæductibus," which was composed by Frontinus in the reign of Nerva or Trajan. Even at the end of the sixteenth century, the cause of the ascent of water in pumps was little known. Galileo could give no better reason for it than that it was caused by an attraction which he supposed the piston exercised on the water; and we are indebted to his pupil Torricelli for the discovery that the rise of the water is owing to the pressure of the atmosphere on the general body of water in the well in which the pump is immersed.

The "Principia" of Newton contains (lib. ii. sec. 7) a series of propositions concerning the motions of fluids, with investigations of the resistance made by fluids to bodies moving in them; and it may be said that his theory forms the groundwork of all our knowledge concerning that subject.

Daniel Bernoulli (in 1738) was the first who applied the higher branches of mathematical analysis in the investigation of general equations relating to the problems of hydrodynamics, and D'Alembert in 1744 still further extended the study. The researches of Euler, Lagrange, Laplace, and other continental mathematicians, have since contributed greatly to establish the principles of the science on an analytical basis. The laws of the motions of fluids in canals and rivers were, with every possible precaution to insure accuracy, determined experimentally by the Abbé Bossut in 1771, and by the Chevalier Du Buat in 1786.

In investigating the circumstances attending the discharge of fluids through orifices, it is usual to suppose the



fluid to be divided into an infinite number of indefinitely thin laminæ perpendicular to the axis, A B, of the vessel in which it is contained, and that in the descent of the fluid these laminæ preserve their parallelism till they come near the orifice, when they assume the shape of a funnel, about which the fluid is stagnant. Let the vessel be cylindrical or prismatical, in a vertical position, and have an orifice at B. Now, if $p\,p'\,q\,q'$ be the edge of such a lamina, its area perpendicular to the axis being represented by a, and if a' be the area of the orifice B; also, if g express the force of gravity, h the height A B, and u the velocity of a particle of fluid at the orifice; then the relation between the velocity, u, and the height, h, may be found from the equation

$$0 = gx - \frac{a'^2}{2a^2}u^2 - gh + \tfrac{1}{2}u^2.$$

Here x is the distance from A to $p\,p'\,q\,q'$. When $x = 0$ then the equation becomes

$$0 = -\frac{a'^2}{2a^2}u^2 - gh + \tfrac{1}{2}u^2;$$

or considering the orifice as infinitely small, so that a' and the whole first term of the second member vanishes, we have $0 = -gh + \frac{1}{2}u^2$; whence $u = \sqrt{2gh}$.

Now gh expresses the weight of a prism of fluid having unity for the area of its base, and whose height is h; and this is the pressure of the fluid against a small orifice at the bottom of the vessel; but while the height, h, is the same, the pressure is the same whatever be the position or inclination of the orifice; therefore $\sqrt{2gh}$ will express the velocity at the same depth, whether the orifice be at the bottom or side of the vessel. By the theory of forces this is equal to the velocity acquired by a body in descending by gravity through a height, h, equal to that of the column of fluid, the orifice being infinitely small.

It may be concluded from the above value of u that the velocity of a fluid, spouting upwards through an orifice in a vessel, would cause it to ascend to the level of the upper surface of that in the vessel, if the resistance of the air were abstracted. This is exemplified in fountain-jets, &c.

It follows also that the velocities of spouting fluids, at different depths below the upper surface, are proportional to the square roots of the depths; so that if two equally sized holes are situated, one a foot and the other 4 feet below the top of a full cistern, the jet of water from the lower hole will be as $\sqrt{4}$ to $\sqrt{1}$, that is, will be twice as violent as that from the upper hole. Therefore the quantities of fluids discharged in equal times at different depths in the vessel, the latter being constantly full, are to one another in a ratio compounded of the areas of the orifices and the square roots of the depths; and the quantity of water which would be discharged in a given time, t, through an orifice, a, in a vessel kept constantly full at the height, h, is expressed by $a't\sqrt{2gh}$.

The velocity u or $\sqrt{2gh}$ expresses the length of a cylinder of water which would flow through the orifice in one second; consequently the time of discharging from a cylindrical or prismatical vessel, the area of whose base is a and whose height is h, a quantity of water equal to that which the vessel will contain, the latter being, however, kept full during all the time that the water is flowing, will be found by making ah equal to $a't\sqrt{2gh}$; whence t (the time required) $= \frac{a}{a'}\sqrt{\frac{h}{2g}}$. The value of g is 32·167 feet or 386 inches; and in these values of u and t it is evident that the areas and height must be of the same denomination as g.

When a vessel is suffered to discharge itself gradually, the velocity of the effluent water diminishes continually; and if the vessel be an upright cylinder or prism, the time in which the vessel would be completely emptied will be found to be double the time in which a like quantity of water would run out if the vessel were kept full.

Next, if it were required to determine the quantity of water which would flow through an orifice of finite magnitude when cut in the vertical side of the vessel, which is

kept constantly full, it must be observed that the velocity of the effluent fluid at different points in the depth of the orifice varies as the square root of the distance of the point from the upper surface. Now let A B ($= h$) in the figure be the vertical height of the water in a vessel in one side of which is formed the orifice whose axis is C B ($= h'$), and let the interval between the parallel lines $m\,n$ represent a vertical section through an indefinitely thin lamina of the effluent water. Then, if the orifice were rectangular, and its breadth were represented by b, the quantity of fluid discharged through the orifice in the time t would be

$$\tfrac{2}{3}\, bt \sqrt{2g}(h^{\frac{3}{2}} - h'^{\frac{3}{2}});$$

and if the orifice extended from the bottom to the top of the vessel, having then $h' = 0$, the expression would be $\frac{2}{3}\, bt \sqrt{2gh}^{\frac{3}{2}}$. If a rectangular orifice of the same form and magnitude were situated at the bottom B, with its longer side ($= h$) horizontal, the breadth b being very small in this, and also in the preceding case, the quantity discharged in the same time t, the velocity of the effluent water being now equal in every part of the orifice, and being that which is due to the whole height, h, would be expressed by $bt \sqrt{2gh}^{\frac{3}{2}}$. The discharge found above is manifestly equal to two-thirds of this quantity.

In the second book of the "Principia," Newton shows that many of the particles of water, previously to issuing from an orifice in a vessel, converge towards the orifice in every direction; so that after passing it they form a stream of diminished breadth, which he called the *vena contracta*. By careful measurement he found the diameter of the latter and that of the orifice to be to one another in the ratio of 21 to 25; and he infers that the velocity in the contracted stream must be to that at the orifice inversely as the squares of those numbers, that is, nearly as $\sqrt{2}$ to 1. Hence, finding from experiment that the velocity in the said stream was equal to that which a body would acquire by falling through the whole height of the fluid column in the vessel, he concludes that the mean velocity in the orifice must be that which is due to half the height of the same column. In practice, when water is made to flow through a small orifice in a thin plate, it is found that the theoretical quantity is always exceeded. The actual quantity discharged in the time t may always be represented with sufficient accuracy by the expression $0{\cdot}62\ at \sqrt{2hg}$, the area of the orifice being expressed by a.

The results of experiments tend to show that when the height of a head of water in a vessel and the diameter of an orifice in its base or side are given, the discharge of water through an *adjutage* (by which writers on hydrodynamics mean a short tube inserted in the orifice), if the length of the adjutage does not exceed three or four times its diameter, is to that through the simple orifice nearly in the ratio of 12 to 11; and it is observed that, with a given diameter at its furthest extremity, the tube, which is formed to coincide as nearly as possible with the natural figure of the *vena contracta*, affords the greatest discharge. The flow of water from an orifice in the side of a properly balanced vessel may be made to produce motion, as in BARKER'S MILL, elsewhere described. Rockets fly and Catherine wheels turn by the same principle.

The passage of water through long pipes is greatly retarded by adhesion and friction in the interior, by the resistance experienced where bends take place, and by the disengagement of air. The general rules deduced from the experiments of Abbé Bossut at Mézières, in 1799, are —that the discharges in given times, with pipes of the same length and with the same head of water, are proportional to the squares of the diameters; and when the diameters are equal, the discharges are inversely proportional to the square roots of the lengths of the pipes. A pipe whose length was 600 fathoms, and which was 12 inches in diameter, when the head of water was 12 feet, afforded a discharge amounting to about a tenth—and a pipe of equal diameter, whose length was 2340 fathoms, when the head of water was 20 feet, discharged only a nineteenth—of that which would have been obtained from a simple orifice.

If the water of a river experienced no resistance from the sides and bed, its motion would go on continually accelerating from its source to its mouth, like a solid body falling by the action of gravity; and the consequences would be, that besides the destruction ensuing from the violence of the torrents in the lower lands, the moisture would be drawn from the soils in the upper regions, which would thus become incapable of supporting vegetable and animal life. The adherence of the particles of water to each other, and the friction against the beds, produce a resistance which increases with the velocity of the current, and becomes at length equal to the accelerative force of the descent; and then a uniform motion is established.

But when a current is in a state of equilibrium, the velocities in different transverse sections of the river may be very unequal, on account of the variations in the areas of those sections, through all of which the same quantity must flow in the same time, since otherwise the equilibrium of the river would not be permanent. It follows that the products of the areas of the sections multiplied by the velocities in each must be equal to each other, and that the velocities in different sections must be inversely proportional to the areas of those sections.

The mean velocity of water in a river may be expressed approximately by the formula

$$307 \sqrt{\frac{r}{l}},$$

in which r is the quotient (in inches) arising from a division of the area of a transverse section of the river by the arc bounding it, that is, by the breadth, if the latter be measured on the surface of the bed; and l is in inches the extent of a portion of the river, between two points in its length whose difference of level is 1 inch. That is to say, the slope of the river is $\frac{1}{l}$. And by experiment it has been found that if $v' =$ the velocity at the surface of the river, v'' the velocity at the bottom, and v the mean velocity as above (all being expressed in inches per second), we shall have

$$v'' = (\sqrt{v'} - 1)^2 \text{ and } v = \tfrac{1}{2}(v' + v'').$$

The mean velocity in any one section may be practically found, tolerably near the truth, by placing in it a rod of wood loaded at one end with a weight sufficient to allow it to float upright in still water. The greater velocity at the upper surface will make the rod incline towards the direction of the stream; and consequently, when it has acquired a state of equilibrium, it will float in an oblique position; the top of the rod will move slower than the water at the upper surface of the river, and the bottom will move faster than that in the lower part. Hence the mean velocity of the water in that part of the breadth of the river may be considered as nearly equal to the observed velocity of the rod. But the experiment must be tried at various distances from the shore, and an average taken.

A knowledge of the velocity at the bottom of a river is of considerable use in enabling the hydraulic engineer to judge of the action of the stream on its bed; and it is evident that, to insure permanency, the accelerative force of the water should be *in equilibrio* with the tenacity of the channel. It is stated that a velocity of 3 inches per second at the bottom will remove fine potter's clay, a velocity of 6 inches will lift fine sand, that of 12 inches will sweep away small gravel, 24 inches will roll away rounded

pebbles, and 3 feet per second will carry along angular stones of the size of an egg. Bossut found that, when the velocity of the stream was just sufficient for lifting the sand, a ridge advanced about 20 feet in a day. The force of the Niagara Falls has been computed at 4,500,000 horse-power incessantly wasted.

When a body moves in a fluid at rest, its anterior surface being perpendicular to the direction of the motion, if an indefinitely thin lamina of fluid be supposed at every successive instant of time to be displaced, the resistance experienced by the moving surface may be considered equal to the weight of a column of the fluid whose base is the surface pressed, and whose height is that which is due to the velocity; that is to say, the resistance may be supposed to be equal to the pressure which would produce the same velocity at an orifice in the base or side of a vessel. Therefore, if the velocity be represented by v, the height due to that velocity is equal to $\frac{v^2}{2g}$; then a representing the area of the moving surface, and D the specific gravity of the fluid, we shall have $\frac{a v^2}{2g}$ D for the pressure against that surface, or the resistance experienced by it, in moving through the fluid. But when the anterior surface of the moving body is oblique to the direction of the motion, the resistance above found must be diminished on account of the inclination. Let I be that inclination; then the effective pressure varies as $\sin.^3 I$; therefore the resistance experienced by a moving plane oblique to the direction of the motion will be expressed by $\frac{a v^2}{2g} D \sin.^3 I$.

If a cylindrical body, terminated in front by an equilateral cone, move through a fluid in the direction of its axis, it can be easily shown that the resistance experienced is one-fourth—and if the body be terminated in front by a hemisphere, the resistance is one-half—of that which would be experienced by the same cylinder if it were terminated in front by a plane perpendicular to its axis. The application of this to the construction of boats, &c., is too obvious to need mention.

The resistances experienced by bodies of various forms and lengths, when caused to move in water, have at various times been the subject of numerous experiments, and the following are some of the more important results of these:—

The friction of bodies moving in water is equal to a power of the velocity whose exponent is 1·949.

The pressure sustained at the head-end varies in rather a higher ratio than the square of the velocity, when the velocity is small, and the exponent diminishes with an increase of velocity. The diminution of pressure on the stern, caused by the fluid not pressing so strongly there when the body is in motion as when at rest, varies in a lower degree than the square of the velocity; and the exponent diminishes with an increase of velocity.

A globe experiences about one-third of the resistance which is encountered by a cylinder. A globe cut in halves, and separated by the intervention of a cylinder whose base and length are each equal to a diameter of the former, experiences a diminution of resistance which, compared with that of a complete globe, is nearly equal to one-fifth of the latter.

Bodies whose head-ends are formed with curved lines have a great advantage in respect of resistance over those formed with right lines.

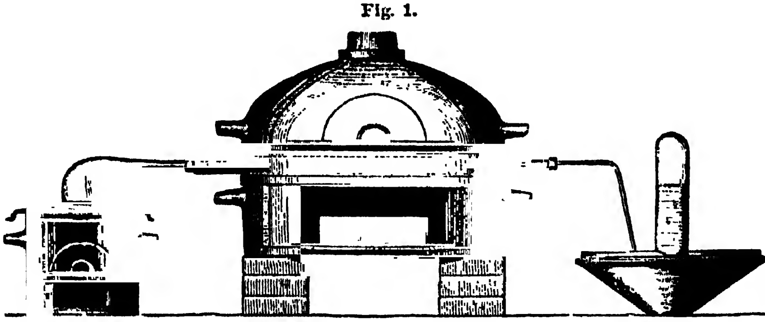
The greatest breadth of a moving body should be at a distance from the head extremity equal to two-fifths of the body's length, that the body may move through the water with the least resistance. Increasing the length of a solid of almost any form by the addition of a cylinder in the middle greatly diminishes the resistance with which it moves, provided the weight in water continues to be the same.

By comparing the resistance of bodies near the surface with those having similar head and stern ends, and which were immersed to the depth of 6 feet, those at the surface were found to experience more retardation than the others.

HYDROFLU'ORIC ACID. See FLUORINE.

HY'DROGEN. This gas, the lightest of all known substances, was first observed by Paracelsus in the sixteenth century as evolved when iron was dissolved in dilute sulphuric acid. Boyle, in 1672, first noticed the inflammability of the gas so produced. Its properties were more completely studied in 1766 by Cavendish, who called it inflammable air, and also estimated its gravity. In 1783 he announced the great discovery of the composition of water, and showed that it consisted of two volumes of hydrogen with one volume of oxygen. All organic compounds contain hydrogen, but it is usually obtained from the decomposition of water. This may be effected by electrolysis, or by passing steam over iron filings heated to redness: the oxygen combines with the iron, and the hydrogen is set free (the apparatus employed is shown in fig. 1); or by the decomposition of water with metallic potassium or sodium: the oxygen combines with the metal forming an oxide, the

Fig. 1.



hydrogen being set free. In the presence of air the action is very violent, and the metal becomes so heated that the hydrogen takes fire; or by the solution of zinc or iron in dilute hydrochloric or sulphuric acids, the metal is oxidized at the expense of the water, and combines with the acid, the hydrogen being set free; this is the method usually adopted on the large scale. Hydrogen may also be obtained by treating formiates and oxalates with alkalies, and in many other ways. The atomic weight is 1; symbol, H. The atomic weights of all the other elements are based on that of hydrogen, and there is a general opinion among chemists that all will ultimately be found to be simple multiples of hydrogen. Graham found hydrogen in a meteorite, and he has shown that it

forms a remarkable alloy with palladium; this metal in the spongy state absorbs 686 times its volume of hydrogen at 200° C. (392° Fahr.); he considers it a true metallic alloy, and that the hydrogen enters into combination in the metallic state, which he calls hydrogenium, and he calculates its specific gravity, from the density of the alloy, to be 0·733. Hydrogen is a colourless, odourless gas, when pure, and of extreme levity. The specific gravity is 0·0693, or about 14½ times as light as atmospheric air. It can be

Fig. 2.

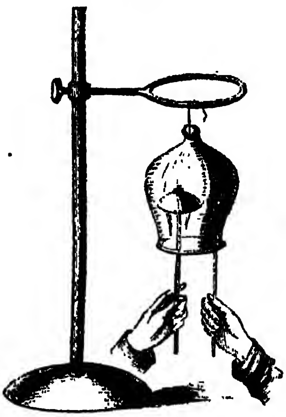
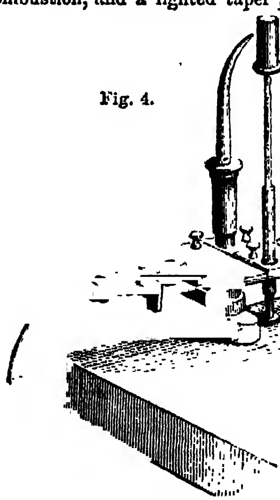


Fig. 3.

easily collected by displacement, and carried in tubes with the mouths downwards. It is the best gas for use in balloons, and even soap bubbles inflated with it rise quickly in the air. It is poisonous when inhaled, as it does not support respiration, but when breathed in small quantity it renders the voice high and squeaking. This may be shown also by suspending a receiver containing hydrogen and passing a bell with clapper up into it; the sound is very different from that of the same bell in air. Fig. 2 shows the arrangement employed. Hydrogen is very inflammable, burning with a pale blue flame, but it does not support combustion, and a lighted taper passed upwards into it is

Fig. 4.

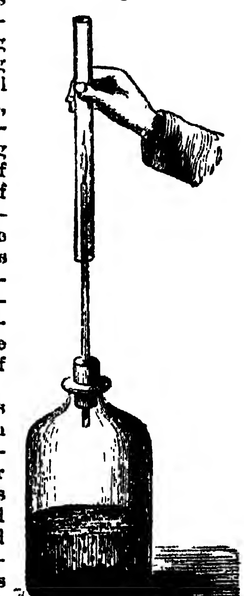


extinguished. When a jet of hydrogen impinges on a piece of spongy platinum the gas is instantly ignited and continues to burn. A constant lamp can be thus constructed, one form of which is shown in fig. 3.

Pictet first succeeded, in 1878, in liquefying hydrogen under a pressure of 650 atmospheres combined with extreme cold about —140° C.; in 1882 Cailletet succeeded more perfectly, and deduced the density of liquid hydrogen, which he puts at 0·033. It has more recently been effected at a pressure of 100 atmospheres by the cold produced by the vaporization of liquid oxygen. The best method of obtaining liquid oxygen, according to Cailletet, is to produce the low temperature required (about − 120° C.) by the evaporation of liquid ethylene.

A mixture of two volumes of hydrogen with one volume of oxygen is extremely explosive. By collecting the gases in a Cavendish tube, a glass vessel of great strength, and passing an electric spark, the mixture can be exploded without noise, a few drops of water being the only result of the experiment; but if the mouth of the containing vessel be open, a loud explosion is the result. A mixture of hydrogen with atmospheric air containing oxygen and hydrogen in anything like these proportions, is dangerously explosive, and many accidents have resulted from careless manipulation with this gas. Explosions often occur with the bags of oxygen and hydrogen used for the oxyhydrogen light, the pressure weights on one of the bags being accidentally removed and the gas drawn in from the other forming an explosive mixture. A red-hot wire is sufficient to cause the explosion. Moreover, hydrogen is extremely diffusible, and passes through membranes and porous substances with great rapidity. The hydrogen flame is intensely hot, and is much used in plumber's work, and in combination with oxygen gives the highest temperature known. It is also employed on the large scale for melting platinum and in heating lime for the oxyhydrogen light. [See Blow-pipe.] The usual form of this apparatus is shown in fig. 4. The hydrogen flame, when the burning jet is surrounded by a long tube, gives rise to a very rapid series of minute explosions, which combine to form a musical note, the pitch depending on the diameter and length of the tube. A complete series of notes may be produced by varying the length and width of the tubes employed. The tube is held over the flame in the position shown in fig. 5. Hydrogen reduces silver and platinum, and throws down the metals from the solutions of their salts.

Fig. 5.



Hydrogen also combines rapidly with chlorine to form hydrochloric acid; the mixture explodes in sunshine or intense artificial light. It unites directly also with iodine and bromine, forming hydriodic and hydrobromic acids. It combines also with some metals and radicles, forming hydrides. With antimony it forms hydride of antimony or antimoniuretted hydrogen (SbH_3); this is a gas always obtained when any compound of antimony is present during the evolution of hydrogen from zinc and dilute sulphuric acid. It is a colourless, inodorous gas, insoluble in water, and burning with a bluish flame, which deposits a bright

mirror of metallic antimony on any cold surface in contact with it. With arsenic it forms hydride of arsenic or arseniuretted hydrogen. [See ARSENIC.] With oxygen it forms two important compounds—the protoxide or water (H_2O), and the peroxide (H_2O_2). The composition of water is eight parts by weight of oxygen to one of hydrogen, or one volume of oxygen to two volumes of hydrogen. For its general properties see WATER.

Peroxide of Hydrogen (H_2O_2).—This oxide is usually obtained by digesting peroxide of barium with hydrochloric acid. The baryta is precipitated by sulphuric acid, and the hydrochloric acid by sulphate of silver. It is a colourless liquid, of specific gravity 1·452; it is difficult to obtain it free from water. It does not freeze at zero, and in a mixture with water the water can be frozen out. It is easily decomposed, the oxygen gas being rapidly liberated to the extent of 475 times the volume of the liquid, especially when the temperature is raised. It is a powerful oxydizing agent, converting arsenious acid into arsenic acid, and sulphurous acid into sulphuric acid, and baryta, strontia, and lime into peroxides. Charcoal, platinum, and some other metals have a catalytic action, and decompose the peroxide into oxygen and water without undergoing any change. Under other circumstances this body has the singular characteristic of acting also as a reducing agent; for instance, it reduces chromic acid, oxygen being at the same time evolved from both bodies.

Peroxide of hydrogen renders ozone inactive, hence Schönbein regards the oxygen in it as positive oxygen and calls it antozone, and that in ozone as negative oxygen, and says that the two combine together. Brodie regards the two atoms as existing in opposite polar states. It is a bleaching agent, and decolorizes many coloured solutions. It was for some time advertised and sold as a nostrum under a fancy name, and much used for bleaching dark hair, and producing the golden yellow tints once so fashionable among ladies. The composition of this preparation puzzled analytical chemists, who could find nothing but water in it, as the excess of oxygen is given off on heating.

Phosphides of Hydrogen [see PHOSPHORUS].—There are three of these: gaseous, liquid, and solid.

Selenide of Hydrogen or *Seleniuretted Hydrogen.* See SELENIUM.

Sulphide of Hydrogen.—There are two sulphides [see SULPHUR]: the protosulphide (H_2S) and the persulphide (HS).

Telluride of Hydrogen or *Telluretted Hydrogen.* See TELLURIUM.

Carbides of Hydrogen.—The compounds of hydrogen and carbon are exceedingly numerous; some are gaseous, others are liquid, and others are solid. The two most important gaseous carbides are methane and ethene. Methane, or light carburetted hydrogen (CH_4), is known as marsh gas or fire-damp; it is often found in coal mines, issuing from the fresh cut surface of the coal, and giving rise to many terrible accidents, owing to its highly inflammable character and the dangerously explosive mixture formed when it is combined with air. It is also found in the mud of stagnant pools and in sewer gas. It is prepared pure by treating sodium acetate with caustic soda and quicklime. It is a colourless inodorous gas, burning with a yellow flame; its specific gravity is 0·559. It is not poisonous, and can be respired to a considerable extent without injury.

Ethene, Ethylene, or *Olefiant Gas* (C_2H_4) is a richly illuminating gas obtained by distilling alcohol with a large excess of sulphuric acid; if a light be applied to a mixture of ethene and chlorine the hydrogen and chlorine unite with flame, and the whole of the carbon is deposited as soot. [See ETHYLENE.] The liquid and solid carbides of hydrogen are known as hydrocarbons, and are found in almost infinite variety. Benzine may be taken as an illustration of a liquid carbide, and paraffin as an instance of a solid carbide. All are noticed under their respective names. See HYDROCARBONS.

HYDROG'RAPHY (Gr. *hudōr*, water; *graphein*, to write) bears the same relation to the sea as geography does to the land. It is a description of the coast-lines, currents, shoals, soundings, islands, and of all things necessary for navigators to know. It includes the surveys of dangerous places, the construction of charts and maps, and the issue of sailing directions for all parts of the globe. In England there is a hydrographical department in connection with the navy, which is constantly employed in making and correcting charts, for which purpose they employ officers in different parts of the world to make observations, and from them official charts are prepared and published at a moderate price for general use. The art of lithography is here very extensively employed.

HYDRO'IDA, the old name for a division of the class HYDROZOA. It has now been united to the oceanic Hydrozoa (Siphonophora), forming the subclass Hydromedusæ.

HYDROKINETICS. See HYDRODYNAMICS and HYDRAULICS.

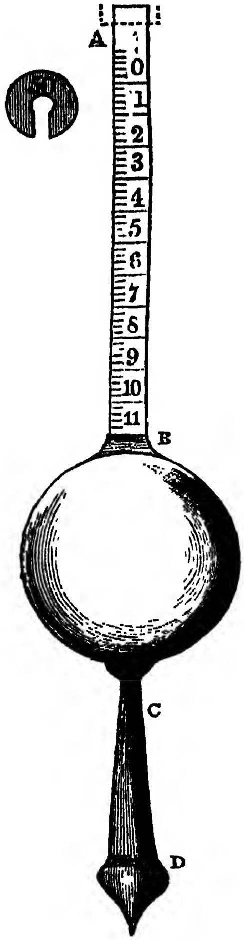
HYDROMECHANICS. See HYDRAULICS, HYDRODYNAMICS, and HYDROSTATICS.

HYDROM'ETER (Gr. *hudōr*, water; and *metron*, a measure) is an instrument for determining the relative densities or specific gravities of fluids. By specific gravity is meant the ratio that the weight of any volume of a substance bears to the same volume of water. Thus a cubic foot of alcohol weighs 793 ounces, while the same quantity of water weighs 1000 ounces, so that the specific gravity of alcohol is said to be $\frac{793}{1000}$ or ·793. A cubic foot of sulphuric acid weighs 1841 ounces, and has consequently a specific gravity of 1·841. The principle of the hydrometer is this:—It is known that when a body is immersed in a fluid it loses as much of its weight as is equal to the weight of that portion of the fluid which it displaces. Hence, if the same body may be immersed successively in two different fluids, the portions of weight which it will thereby lose will be directly proportional to the specific gravities of those fluids. The body in this case is supposed to be specifically heavier than the fluid. If it be lighter it will float upon the surface, so that its tendency to descend, or its weight, will then be entirely counteracted by the fluid; from which it appears that, when a body floats upon the surface of a fluid, the weight of the portion of fluid displaced is equal to the entire weight of the body. Now, since the weight of the fluid displaced by a floating body is constant (being always equal to the weight of the body), whatever may be the density of that fluid, it is obvious that if we can determine how much of the body is immersed we may immediately deduce the specific gravity of the fluid; because, when the weight is constant, the specific gravity varies inversely as the bulk.

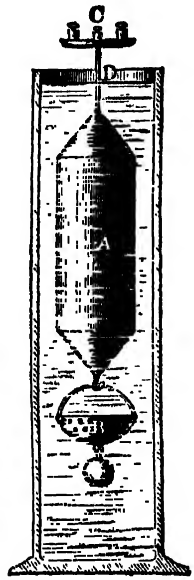
Upon this principle is constructed the well-known instrument called Sykes' Hydrometer, which is now used in the assessment of the spirit revenue of Great Britain. It consists of a thin brass stem A (see cut) about 6 inches in length, passing through and soldered to a hollow ball B of the same material, and about $1\frac{1}{2}$ inch in diameter. To the inferior extremity of the stem, from which the hollow ball is about one inch distant, a permanent pear-shaped weight C D is attached, so that, when the instrument is placed in a fluid, the other extremity may float perpendicularly to the surface. There are also ten weights of different magnitudes (one of which is illustrated in the cut), by the successive application of which the instrument may be sunk so as to obtain the complete range of specific gravity, from that of pure alcohol to that of distilled water. In fact, so exact and correct is the instrument now made that the addition of even a quart of water to 100 gallons of any spirit may be easily detected. Although rather difficult to convey a clear idea of the

instrument and its use in print, in practice its application is exceedingly simple when guided by the rules and tables which always accompany it.

Another form of hydrometer is Nicholson's, which consists of a brass tube A, about an inch in diameter, with conical-shaped ends. On the lower part is fixed a hook, which holds the cup B, and on the upper end a wire is fixed bearing a cup C, on which the weights are placed. On the wire is a notch D, which is made to serve as a point



Sykes' Hydrometer.



Nicholson's Hydrometer.

to which the hydrometer is sunk, the whole being kept vertical by the weight of the cup and the ball which hangs to the bottom of the cup B.

A very convenient method of obtaining the specific gravities of fluids is by means of what chemists call a "thousand-grain bottle." This is a bottle of a globular form, with a ground glass stopper, so adjusted as to contain exactly 1000 grains of distilled water, at the temperature of 60° Fahr., and accompanied by a weight, which is an exact counterpoise for the bottle when thus filled. In order to determine the specific gravity of a fluid by this means, it is simply necessary to fill the bottle with that fluid at the temperature of 60°, and place it, together with the adjusted weight, in the opposite scales of a delicate balance; then the number of grains which it will be found necessary to add to one of the scales, in order to produce equilibrium, will be the difference between the specific gravity of the fluid and that of water, taken at 1000.

HY'DROMYS is a genus of rodents belonging to the family Muridæ, remarkable for having only two molar teeth on each side in each jaw. These rodents are exclusively confined to Australia and Tasmania. They are aquatic in their habits and are called water-rats. The largest species are about twice as big as an ordinary rat. The body is slender and rat-like; the tail is long, remarkably thick at the root, and clothed with short hairs. The fore legs have five toes on each foot; the toes of the hind legs are partially webbed. The best known species are the Yellow-bellied Water-rat (*Hydromys chrysogaster*) from New South Wales, and the White-bellied Water-rat (*Hydromys leucogaster*) from New South Wales and Tasmania.

HYDROP'ATHY, or more correctly *Hydrotherapeia*, commonly known as the *Water Cure*, is the art of treating diseases by the application of water in various ways and at varied temperatures. The use of water as a remedial agent dates from the earliest times in which we have any authentic records of medical treatment. Hippocrates frequently alludes to the use of both cold and hot baths in the treatment of many forms of disease, while in the importance he attached to diet, and his belief in the *vis medicatrix naturæ*, he anticipated also important features in the modern system. References to the use of water in the cure of diseases, especially of fevers, are also to be found in the writings of both Celsus and Galen. During the middle ages there were many physicians of eminence who advocated the use of baths in the treatment of both acute and chronic diseases; but systematic water treatment does not seem to have been adopted until the beginning of the sixteenth century in Italy and France, and in both countries it afterwards passed into oblivion. In the beginning of the eighteenth century the system was revived in Italy, and was also advocated in England by Sir John Floyer and Dr. Baynard, who published a joint work upon the subject. Towards the close of this century James Currie, the biographer of the poet Burns, William Wright, T. Jackson, and others reintroduced the cold-water treatment of fevers; but their methods were not adopted by their contemporaries, and were almost forgotten, when, somewhere about the year 1827, a Silesian farmer named Vincent Priessnitz adopted the plan of using water alone for the cure of disease. Priessnitz had received little or no education, and was totally unacquainted with anatomy, physiology, or chemistry, and his discovery of the art in question was the result of an accident, improved by his keen observation and unusual sagacity. His first experiment was the use of a cool wet bandage to the chest of his own child, who was suffering from bruised ribs, and its beneficial results, which he carefully noted, led him to use a form of the wet-pack when the same child was afterwards suffering from fever. His success caused him to be sought after by his neighbours for the treatment of all kinds of febrile complaints, and his fame gradually spread year by year until the small town of Grafenberg, on the slope of the Silesian hills, and the large house he had erected in it for the reception of patients, were crowded by persons who had come from all parts of Germany, from Russia and Poland, and from Italy and England to seek relief for some malady or other from the Silesian farmer. Priessnitz introduced in his practice the use of the dry pack followed by cold affusions, the wet-pack in several of its forms, the use of friction combined with the wet sheet, the douche, wet abdominal belts and wet compresses, as well as making extensive use of full and partial baths. He also laid great stress upon the necessity of pure air and exercise, and recommended a liberal diet to his patients, though all alcoholic beverages and tea and coffee were forbidden, and the most copious drinking of cold water was insisted on. Wonderfully successful in the great majority of the cases

he treated, his want of physiological knowledge led him to make grave mistakes in some instances; and when his system began to be adopted by others no better furnished than himself with medical knowledge, and destitute of his genius and sagacity, its failures almost caused it to be regarded as merely a system of quackery and imposture. In England, however, several intelligent and scientific physicians had been devoting themselves to the study of the matter, and in 1841 Dr. Wilson and Dr. Gully each commenced the practice of hydrotherapeia at Malvern, and by their publications pressed the acceptance of the new method upon their professional brethren. Since then it has been gradually growing in favour with the medical world, and a large number of establishments have been erected in different parts of England where hydrotherapeutic measures alone, or in combination with the ordinary methods, are adopted for the cure of both acute and chronic disease. Many of the methods adopted at these institutions have also been introduced into hospital practice, especially in the treatment of febrile complaints, and from the good results already obtained it seems likely that they will yet come more largely into use.

Such is briefly the history of the hydrotherapeutic art of healing up to the present day, and we now pass to the description of the chief modes of applying water which are adopted in its treatment.

For general purposes diseases may be conveniently divided into two great classes—those of a plethoric or inflammatory type, caused by a reaction of the organic strength upon some offending cause, such as cold, heat, bad food, poisons, fatigue, violence, &c.; and those of a depressing and lowering kind, marked by weakness and exhaustion of the vital powers, either local or general. Hence the modes and processes adopted are divisible in a general way into those which have a soothing influence and such as have a tonic or stimulating effect upon the body. In the former are the different modes of wet packing, fomentation hot or cold, compresses, sitz baths, and general warm but not hot baths; in the latter are the general cold bath, the douche, very hot general baths, short cold sitz baths of still or running water, shower baths, plunge baths, and dripping sheets applied with friction. The following is a brief description of the more important methods:—

Packing or Envelopment in Wet Sheets or Cloths.—Over the mattress of a bed or sofa one or two stout blankets are spread, and a linen or cotton sheet wrung out of cold water is laid upon them; the patient is then placed upon the sheet in a recumbent posture, and the sheet being folded over the entire body, the blankets are wrapped tightly round the sheet, and as many more are added as may be necessary to exclude all air and insure the warming of the enveloped person by the natural heat of the body acting upon the damp linen. When reaction is fully established the wet pack may be removed and the body well rubbed with dry towels. When profuse perspiration is desired the patient must be well enveloped in blankets and allowed to remain within them an hour or more.

Packing has a cleansing and opening effect upon the pores of the skin, the secretions of which it increases, and it also augments the secretions of the kidneys, and by equalizing the temperature over the whole surface of the body, it tends to relieve internal congestions and soothe the nervous system. The quietude it imparts, especially in chronic diseased conditions, is so great as often to engender sleep of the most refreshing kind; and even in intense febrile states sleep very often ensues upon the single or repeated application of the wet sheet if it is not obtained during the application. In warm or hot wet packing the cloths are wrung out of hot water; in the cooling pack the wrappings are loose and scanty, and permit evaporation; the rubbing wet pack consists in the use of friction with the cold wet sheet, while local packing may be applied to the trunk, head, or limbs separately, and may be either soothing or stimulating, as circumstances require.

Fomentations consist in the application of a towel more or less strongly wrung out of hot or cold water to the part affected, and covered with a dry woollen tissue. They differ from partial packing in the fact that the wet towel is changed more frequently, and they are therefore adapted to cases where the irritation is of an acute character, and such as call for prompt alleviation of the symptoms.

Compresses are pieces of folded towelling wrung more or less completely out of cold water and covered with thick dry towelling, flannel, or some waterproofed tissue. Compresses are applied to all parts of the body, either to subdue irritation on the surface or by exciting irritation there to give relief to some internal part of the body. They are warm and heating when covered with waterproof material, but they are used in local inflammations to produce a cooling effect, by leaving them exposed to the influence of evaporation.

Sitz baths (Ger. *sitzen*, to sit) are such as immerse only the lower parts of the body, and they are used either cold or tepid or with running water. Cold sitz baths act as sedatives, in withdrawing blood from the head, but the attraction of the blood to the lower parts of the body induces increased activity in their sensational and secretional functions. Reaction after such baths is essential, and brisk exercise is necessary to obtain it; hence where the physical strength of the patient is insufficient for this indispensable condition of exercise the tepid bath is used instead.

The uses and physiological effects of general cold, warm, hot, and vapour baths have already been given [see BATH], and reference has also been made to the use of the impact of a jet of water directed against any part of the body [see DOUCHE]; the minor applications of the bath, such as partial sponging, cold foot-baths, &c., do not call for detailed explanation. In addition to the use of the various baths enumerated, the founder of hydrotherapeia (Priessnitz) laid great stress upon the application of water to the interior membrane of the body, and he instructed his patients to swallow as much as they could. Instances are numerous in the history of his practice in which the patients drank from twenty to thirty tumblers of water a day, sometimes with very disastrous results. It has been found in practice that an increased ingestion of water tends to increase the rapidity of the chemical changes of the body, and by augmenting the secretions gives rise to an increased elimination of waste products. By the removal of these the body is enabled to take up a larger amount of new substance, and at the same time the secretions of bile, saliva, and pancreatic juice are also increased. It also has a tendency to quicken the action of the bowels, and a tumbler of cold water taken the first thing in the morning will often relieve habitual constipation, but at the same time it has been found that excessive water-drinking interferes seriously with the digestive powers, and causes grave interference with the circulation. In consequence water is now generally used internally only either as part of the diet or in conjunction with other processes, such as sweating, &c. In the case of those diseases, however, which are marked by much thirst the old custom of forbidding water has given way to a more rational treatment, and it has been found that the free use of water, given in small quantities at a time, not only greatly alleviates the suffering of a fever, but also assists in the cure of the disease.

Passing now to the consideration of such diseases as may be most suitably treated by means of hydropathy, we may note that its value in cases of fever is generally admitted throughout the medical profession. The typhoid form is that in which it has been most generally adopted and in

which most observations have been taken, and its mode of application is as follows:—When the temperature of the patient reaches 102° or 103° Fahr. he is placed in a bath about the normal temperature of the body (98° Fahr.), and the temperature of the water is gradually cooled down, by pouring in cold water or by the addition of ice, until it reaches from between 80° to 60°, according to the patient's reaction. The immersion is continued for ten, fifteen, or twenty minutes, and then the patient is wiped dry, placed in bed, and covered with blankets, a reduction of temperature of from 1½° to 5° Fahr. generally taking place within an hour of the bath. The appliances necessary for this procedure consist merely in the bath itself, a strong sheet for lifting the patient in and out of it, and a clinical thermometer for noting the temperatures of the bath and body. During the height of the fever from three to five baths may be nécessary every twenty-four hours, later on two will be sufficient, and finally only one. The earlier the baths are commenced in the disease the greater seems to be the influence they exert, and it is said that where this mode of treatment is adopted the mortality is less and the complications fewer. Scarlet fever and hectic fever have also been treated with advantage by similar means, while in the extreme temperatures sometimes reached in cases of rheumatic fever the use of very cold and prolonged baths and the application of ice often afford the only chance of saving the patient.

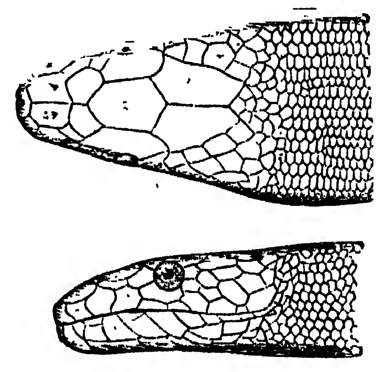
Cases of metallic poisoning, where the system is under the influence of lead, mercury, &c., are often greatly benefited by the vapour or Turkish bath or the wet pack, and in addition to copious perspiration the secretions of the internal organs should in such cases be stimulated by the drinking of large quantities of water. The amount must be regulated by the condition of the patient, and may vary from half a dozen tumblers up to twelve or fifteen a day. In cases of skin weakness, or where chronic affections of the skin exist, the hydrotherapeutic treatment is often of the highest value, and the same may be said of almost all forms of digestive derangement. The benefits derived in many cases of muscular rheumatism from the hydropathic treatment at its commencement led its promoters to believe they had found a specific for this complaint, and though experience has shown that this is not the case, there is no doubt that the treatment is often effective where other methods have failed, and that it is a remedy of the highest value. Mild cases of gout have also frequently been treated with great advantage by the use of hydrotherapeutic measures, but such treatment is not suited for the more serious forms of this disease. Hysteria, hemicrania, and many forms of neuralgia, affections which arise from weakness, nerve excitement, and imperfect nutrition, are often relieved by means of this treatment, and obstinate catamenial irregularities frequently give way before the use of the hip-bath. In cases where the discharge is too profuse the cold hip-bath used for a short period, say from three to five minutes, is generally adopted, and warm hip-baths used for a longer period are recommended where it is insufficient. Tonsilitis, diphtheria, and spasmodic croup are often greatly benefited by the local application of ice, by cold affusions, or the use of the wet pack to the neck, and the cold sitz bath is of the highest value in cases of seminal weakness and spermatorrhœa.

It will be readily seen that to carry out a system of hydrotherapeutic treatment somewhat extensive appliances are necessary, and the adjuncts of pure air and facilities for exercise are not always easy of attainment. In many of the establishments that are devoted to the system these advantages are secured, and the patients healed have the benefit of medical advice in addition that is often of the highest character. It is to be regretted, however, that the benefits of the treatment are not more readily accessible to persons of moderate means, and that suitable establishments are not erected sufficiently near to large towns to enable patients to visit them without altogether ceasing to pursue their ordinary avocations. Some of the milder methods of hydropathy also seem peculiarly adapted for home use in the treatment of simple ailments, but they are seldom advised by the general medical practitioner, and but few persons are acquainted with their use.

The literature on this subject is, however, already very extensive, and among the manuals that have been written by the advocates of the system there are several which are designed for non-professional readers. (See Johnson's "Domestic Practice of Hydropathy," 1849; Shaw's "Hydropathic Family Physician," 1857; Smedley's "Practical Hydropathy;" and Hunter's "Hydropathy for Home Use," 1879.)

HY'DROPHANE is an opaque white variety of opal; it becomes transparent when immersed in water, which it absorbs readily.

HYDROPH'IDÆ is a family of serpents (Ophidia), which, with the ELAPIDÆ, forms the suborder Proteroglypha, characterized by the possession of grooved poison fangs. The Hydrophidæ are sea-snakes distributed throughout the tropical seas; they are never found in fresh water or on dry land. The body, in order more easily to cleave the waves, becomes slender towards the two extremities, and much compressed or flattened towards the tail. The belly is narrow and most frequently prolonged into a more or less sharp keel—a conformation absolutely similar to the keel of a ship. The tail, short, but so compressed or flattened as to offer little breadth compared with its extraordinary height, is the chief organ of locomotion; for by this form, by its vertical position, and its great degree

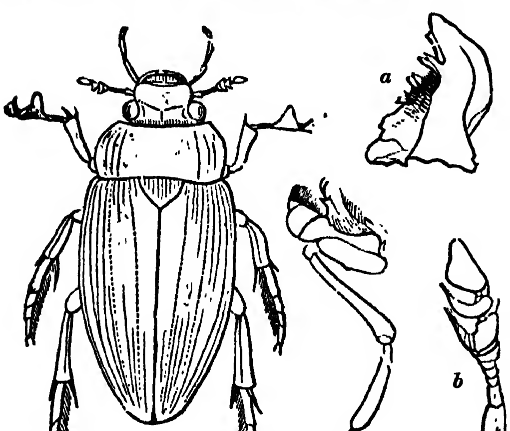


The Black-backed Pelamis (*Pelamis bicolor*).

of flexibility laterally, it exercises at once the double function of oar and rudder. The head is small, more or less elongated, conical towards the snout, and almost of the same proportion as the neck; so that it is well fitted for overcoming the resistance offered by the water. The eyes, placed laterally, are directed a little upwards and forward, and thus these serpents are enabled to look in all directions, so as to be able to seize their prey or escape the dangers with which they are incessantly threatened. The muzzle is elongated into a downward but pointed shield, which closes the mouth and thus prevents the water from entering; and in order to effect respiration without the serpent having need to expose any part of its body out of the water, the nostrils are placed near each other upon the summit of this muzzle, and are provided with a membranous valve, which opens to admit the air and closes to prevent the entrance of the water. A single instant suffices the creature to perform the act of breathing, which effected, it plunges again into the depths of the sea, the water of which cannot enter either by the nostrils or the mouth.

The tongue is much less developed in the sea than the terrestrial serpents. As long as they are below the surface of the water they never make use of this organ; but when they are out of the element, and the animal is blinded, as it were, by the light, it appears of material use as a feeler. The eyes are generally small, and the pupil is always round. The mouth is only of moderate size, and the jaw-bone is sufficiently long to give room, in addition to the fangs, to several small solid teeth. Hence it follows that these sea-snakes cannot erect their fangs so much as the viperine serpents, and in biting their prey they retain hold of it with their jaws. The fangs are marked on their hinder edge with a furrow, which communicates with the orifice of the duct that conveys the poison from the gland. They are very small. The other teeth are small and numerous. The poison-gland is also less developed than in the true venomous serpents, forming a narrow pear-shaped sac. The skin which covers the body is very loose and easily detached, and the scales upon it are generally hexagonal in shape and small. There is a peculiarity in the structure of the lung in sea-snakes which adapts them for their method of living. It is a long narrow canal, swollen out in some parts of its course into tolerably sized sacs; and as it extends as low down as near the extremity of the intestine, it is at once both an organ of respiration and an air-bladder. The size of these sea-snakes varies in the different species. Some are not more than 2½ feet long, while others reach a length of 5 feet. The females are ovoviviparous, that is, they retain the eggs till hatched: the sexes cannot be distinguished externally. These sea-snakes are usually of a yellowish colour, shading sometimes to a green, sometimes to a blue or to white, and most frequently relieved by numerous blackish bands, or by large lozenge-shaped spots disposed in a transverse manner along the back. They are very venomous. This family comprises the following genera—Hydrophis, Pelamis, Enhydrina, Platurus.

HYDROPH'ILUS is a genus of water-beetles belonging to the family Hydrophilidæ, and the group PALPICORNIA. The body is ovate-oblong, convex above and flat below; the hind legs are formed for paddling; the antennæ are short and knobbed, and the maxillary palpi long. The best known species is *Hydrophilus piceus*, which is the



Hydrophilus piceus (male)—*a*, the mandible; *b*, antenna.

largest water-beetle found in Britain. These insects are very bad swimmers, notwithstanding the oar-like structure of their four hind legs. Their food consists principally of vegetable substances, although in captivity they eat greedily the larvæ of other aquatic insects and aquatic molluscs. They breathe by bringing their heads to the surface. The insects often leave the water, especially at night. The females construct, by means of tenacious fluid secreted by two spinnerets in the anus, a cocoon, which they attach to water-plants on the surface of the water. The cocoon is of a short pear-shape and of a paper-like substance. The eggs are regularly arranged within, and are wrapped up in a cottony substance. They are hatched in six weeks. The larvæ are animal-feeders, and are among the fiercest hunters of the pond. When about to undergo the transformation into the pupal state they crawl out of the water; the pupæ bury themselves in the ground.

HYDROPHO'BIA (Gr. *hudōr*, water; and *phobos*, fear) is the disease occasioned by inoculation with the saliva of a rabid animal, and is so called from the violent and suffocating spasms of the throat which occur when the patient attempts to drink, or when, in the later stages, the mere idea of drinking arises in his mind. The exciting cause of this disease is the poison of rabies, which is generated in the dog and various animals of the canine species, such as the wolf, fox, and jackal; and which may by them be communicated to other animals, such as cats, horses, pigs, and also to man. It is a disease of considerable antiquity, an account of its phenomena being found in the works of Aristotle, and there are references to it in the poems of Homer and the works of Xenophon, Plutarch, and Pliny. According to some authors the disease may arise spontaneously in dogs and other flesh-eating animals, from a variety of causes; but such a theory is totally destitute of proof, and most modern observers believe that it never arises except as a result of inoculation from some animal already suffering from the disease.

The disease may be communicated to man either by the saliva being carried into a wound made by the tooth of a rabid animal, or by its being placed on the surface of a previous wound, as where dogs have licked the hand or face of a person in which there was any raw surface. The poisonous saliva appears to be powerless to exert any influence through the unbroken skin, though Youatt believed it might pass through the mucous membrane, and one case is recorded in which the disease arose through the teeth being used to loosen a knot upon a rope with which a rabid dog had been tied. Statistics show that the large majority of those who are bitten by mad dogs escape hydrophobia, and this is supposed to arise chiefly from the fact that if the bite has been through the clothes the saliva has probably been wiped off the teeth as they passed through. In other cases, where the face or hands have been bitten, the poison may have been washed out by the free bleeding of the wound, and there seems also to be occasionally an individual insusceptibility to its effects. The whole mortality arising from this cause in Great Britain in one year is seldom more than twenty-five cases, and it is often as low as eleven.

The period after the inoculation at which the symptoms of hydrophobia may exhibit themselves varies greatly. In general the disease appears between the thirtieth and fortieth day from the injury; but cases are known where it has been delayed for several months. The bite of a rabid animal generally heals up like that of a healthy one, and the patient is attacked when he has forgotten that he was ever bitten. In some cases, however, before hydrophobic symptoms appear, the scar of the wound becomes painful, red, and swollen, and pain is felt shooting from it along the course of the nerves of the part, as if it were going to ulcerate. The first decided indication of the disease is that the patient has headache and general uneasiness; he loses his appetite, and when he is about to drink he suddenly feels an aversion to any liquid, and finds a difficulty in any attempt to swallow it. The symptoms rapidly increase in severity; any attempt to

drink, and even anything that can suggest the idea of drinking, is sufficient to bring on the most frightful spasms of the throat, threatening instant suffocation, and producing the most severe pain. The convulsions, which were at first limited to the muscles of the throat and of deglutition, after a short time extend to other parts of the body. As the disease proceeds the convulsions of the throat become more frequent and severe; the slightest noise or vibration of the room is sufficient to excite them; there are severe headache, a rapid pulse, a foul tongue, and other symptoms of a generally disordered condition of the system. A copious secretion of thick tenacious mucus clogs up the air passages, and it is in his attempts to free himself from this that the patient coughs and makes a loud harsh noise, which has been supposed to resemble the barking of a dog. Sometimes there is furious delirium, but often for the last few hours of life the patient becomes quiet; he then rouses from his tranquillity, and, after one or two comparatively slight convulsions, expires. The duration of the disease is very rarely more than six days, and it often terminates fatally in twenty-four hours.

It was formerly supposed that the disease might be communicated by the patient to his attendants, hence when persons were found to be afflicted they were either left to their fate, or a vein was opened and they were allowed to bleed to death. Such fears appear to be entirely groundless, and though prudence dictates that all saliva from the mouth of a patient should at once be washed away if it touches the face or hands of an attendant, and that when a bite is received it should be cauterized, there is no authentic instance recorded, of all the cases that have been treated, where the disease has been contracted by attendance during life or inspection after death.

With regard to the prevention of this malady there seems to be no doubt that it may be accomplished by the removal of the morbid saliva from the wound before it has had time to produce its influence upon the body. If possible a ligature should be placed above the wound immediately after it is inflicted, and the place should then be sucked and the wound allowed to bleed freely. No danger is incurred in sucking the part provided there is no abrasion of the lips or tongue, though the mouth should be rinsed with water, or vinegar and water, if it can be procured. Then as soon as possible the wound should be freely cauterized, or the affected part cut right out with the knife. A stick of lunar caustic is very useful in cauterizing a wound of this kind, and Mr. Youatt, who was himself bitten seven times by mad dogs, and who attended successfully over 400 other cases, was accustomed to rely almost entirely upon it. Other chemical caustics, such as nitric acid and liquid carbolic acid, have been used, and the application of a red-hot iron sufficiently long to secure the complete destruction of the part penetrated by the teeth is equally effective. Even where a wound has healed, the place should be cauterized if any suspicion arises as to the condition of the animal by which it was inflicted.

With respect to the treatment of the disease when it has become fully developed, up to the present no remedy has been discovered, and though a few instances of recovery are recorded it is almost invariably fatal. There are several so-called specifics for hydrophobia, some of which have a considerable local reputation, but they are regarded as valueless by the medical profession. There are numerous ingredients in their composition, but the active principle in them all is derived from the leaves of the common box. Sedatives, sweating, acids, and such powerful drugs as curara and Calabar bean, have all been tried in the treatment of this disease; but they have all been found ineffective to cure, though they may mitigate the sufferings of the patient.

Considerable light, however, has been cast upon the nature of this disease during the past few years by the researches of M. Louis Pasteur of Paris, and there is good reason to hope that a method of prevention, if not of cure, will ultimately be discovered. It is now generally believed that the poison of rabies, like that of other forms of zymotic disease, is due to the existence of bacteria, which increase and multiply in the system. From experiments made at the commencement of 1881 with the saliva of dogs affected with rabies, M. Pasteur obtained proof that hydrophobia is a brain disease extending to the spinal cord and to the whole nervous system, and he inferred that the virus passed from certain nerves into the salivary glands. Following upon the lines of his previous studies already noticed under BACTERIA, he tried the effects of the venom upon rabbits, guinea-pigs, monkeys, &c., and found as a result that he was able to obtain it in an "attenuated" form and with various degrees of strength. The next step was to inoculate certain healthy dogs with the attenuated virus, and then to cause them to be bitten by an undoubtedly rabid animal, and it was found that a dog so protected was proof against infection. Subsequent experiments appeared to prove that when a healthy dog is bitten by a rabid animal, and is then inoculated with the attenuated virus within a period of eight days afterwards, hydrophobia does not manifest itself. As it was considered by M. Pasteur that this might be the means of saving human life *after* the bite of a rabid dog, patients began to arrive at Paris from all parts of France, and even of Europe, for treatment by him. His private resources were taxed to the uttermost, and it soon became necessary to appeal to government for aid to found an institute for the treatment of cases of bites from rabid animals. The benefits of this institution were extended to the whole civilized world, patients from Russia, and even from America, having been treated in general with gratifying success, though the occurrence of several failures proves that the method is not yet infallible. The signs indicative of approaching rabies have been summarized by Dr. Burdon Sanderson as follows:—

"The animal loses its natural liveliness, mopes about, and seeks to withdraw into dark corners; its appetite becomes depraved; it eats rubbish, often its own excrement, with avidity, and it snaps at other dogs. Any such appearance of snapping shows it is not safe. A healthy dog which is at large notices and takes an interest in the sights and sounds when walking out. The rabid dog, on the contrary, goes sullenly and unobservantly forward, and is not diverted by objects obviously likely to attract it. If the dog be tied up, its bark loses its ring, and acquires a peculiar hoarseness. As the disorder increases, a viscid saliva is discharged from the mouth, the lower jaw hangs as if paralyzed, the poor animal has an evident difficulty in swallowing, and he probably loses the power of his hind legs." During the progress of the disorder there is no fear of water in the dog. In a rabid state his thirst is excessive, owing to the uncomfortable viscid condition of his mouth and throat. Instead of running away from water, he plunges his face into it up to the very eyes, and assiduously but ineffectually attempts to lap. Though generally associated with "dog days" and intense heat, rabies is as much a disease of winter as of summer, and even more prevalent in arctic than in tropical climates.

HY'DROPHYLLA'CEÆ, an order of plants belonging to the cohort Polemoniales, among the GAMOPETALÆ The typical genus of the order is Hydrophyllum (waterleaf), the species of which grow among moist shady rocks. The leaves of *Hydrophyllum virginicum* are eaten in North America under the name of Shawanese salad. The leaves of *Hydrolea zeylanica* are used in India as a poultice for ulcers. Species of Nemophila and Phacelia are cultivated in gardens as border plants.

The chief characteristics of this order are the following:—The corolla is regular, with five imbricate, sometimes

contorted lobes. The five stamens alternate with the corolla lobes. The ovary is one-celled, with many ovules on parietal placentas, or two-celled from the intrusion of the placentas to the centre. The style has two branches, or there are two distinct styles. The fruit is a two-celled capsule, dehiscing loculicidally. The embryo is small in fleshy albumen. The species are natives chiefly of the colder regions of North America, and a few are also found at the Cape and in the East Indies.

HYDROQUIN'ONE or **HYDROCHINONE.** Two substances are known under this name, one colourless, or pyroquinole, the other a green compound, called also quinhydrone. Pyroquinole is isomeric with oxyphenic acid, and is produced by the action of reducing agents on quinone. It forms colourless rhombic crystals, which sublime unchanged; it melts at 177° C. (350° Fahr.) It is soluble in water, alcohol, and ether. The formula is $C_6H_6O_2$. It differs from quinone by two atoms of hydrogen. Quinhydrone, or green hydroquinone, has the formula $C_{12}H_{10}O_4$. It is a compound of pyroquinole with quinone. It crystallizes in green prisms, having a golden metallic lustre by reflected, and a red colour by transmitted light. It sublimes unchanged. It is soluble in water, alcohol, and ether. Hydroquinone forms a great number of derivatives, of which the following are the best known:—Carbohydroquinonic acid ($C_7H_6O_4$); the sulphohydroquinonic acids, of which there are three; and the chlorinated hydroquinones, of which there are four, arising from the substitution of one, two, three, and four atoms of chlorine respectively for an equal number of atoms of hydrogen. Hydroquinone is used as a febrifuge, particularly by hypodermic injection.

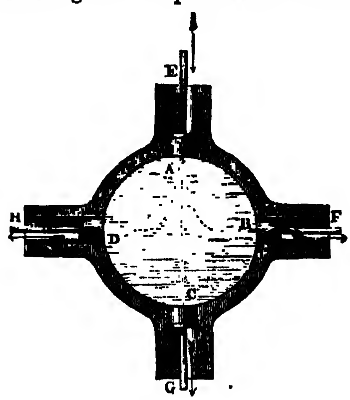
HY'DROSALICYL'AMIDE is produced by the action of ammonia on hydride of salicyl. It crystallizes in colourless prisms, insoluble in water, but soluble in boiling alcohol. It melts at 300° C., and sublimes unchanged. The formula is $C_{21}H_{18}N_2O_3$. It forms a number of metallic salts, in which the hydrogen is partly replaced by an atom of the metal. It forms also chlorine and bromine derivatives.

HYDROSTAT'ICS is the science which relates to the pressure and equilibrium of liquids, that is, the fluids commonly called non-elastic or incompressible, as water, mercury, &c., and to the equilibrium of bodies immersed in them. The elastic fluids, as air, steam, &c., are the subjects of PNEUMATICS. The two books of Archimedes on the subject almost exhaust the knowledge of the ancients on this matter. A slight acquaintance with some principles of equilibrium, and the great discovery of the varying specific gravity of bodies, were his chief contributions. The well-known tale of his detection of the goldsmith who had alloyed the crown, by immersing it in water and measuring the fluid displaced, is told in the article ARCHIMEDES.

The cause of fluidity in liquids has been the subject of much discussion; but whatever may be the primary cause, it is admitted by all that the property must arise immediately from the perfect mobility of the particles among one another. Differences, however, exist in the fluidity of different liquids, such as mercury, water, &c., which in their ordinary state possess this property in a high degree; while the particles of many fluids, as the oils, have a sensible adhesion to one another.

Since the particles of all bodies, fluid as well as solid, are separated by intermolecular spaces, it may readily be conceived that no liquids can be absolutely incompressible; and experiments have proved that spirit of wine, oil, water, and even mercury, can by pressure be reduced in volume in certain degrees, the liquids which have the greatest specific gravity suffering the least compression. But as this diminution is very small when compared with the volume of the fluid (being for water only $\frac{1}{21740}$ of its bulk with a pressure of 15 lbs. on the square inch), for all practical hydrostatic purposes such liquids may safely be considered as experiencing no change of volume by the compressions to which they may be subjected.

Experiment has also shown that all liquids possess the property of transmitting equally in every direction the pressure exerted against any point on their surface. This property is the fundamental principle of hydrostatics, and most of its other propositions are only different forms or direct consequences of this truth. If, for example, a piston were forced into an orifice made in any part of the side of a vessel containing such a liquid, the effect of the pressure would be experienced equally at every point on the whole surface of the vessel; but the pressure thus exerted must be distinguished from that which is caused by the gravity of the liquid, the former being the same in every part of the liquid mass, while the latter, at every point in the sides, depends on the depth of the point below the upper surface of the fluid. Thus if a number of pistons, F G H, be fitted into a globe filled with water, A B C D, then the thrusting in of the piston E will drive out all the

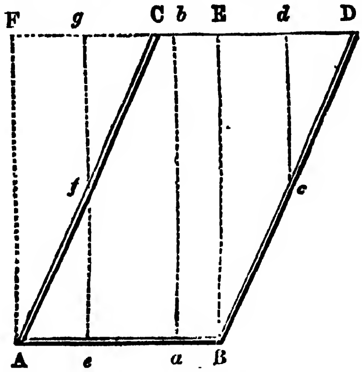


others with a force equal to its own and to each other's, clearly showing that the pressure has been transmitted equally in all directions.

If a liquid at rest in a vessel be supposed to consist of an infinite number of filaments or infinitely slender columns in vertical positions, the pressure which, in consequence of the weight of the particles vertically above, is exerted in every direction by any particle of one filament will be counteracted by the equal pressure of all the surrounding particles, so that the filament will remain at rest, and act by its gravity on the particle vertically under it. Also, the pressure exerted by the liquid against every part of the surface at the sides or bottom of the vessel containing it will, while the liquid is at rest, be perpendicular to the surface; since otherwise the reaction of the surface could not entirely destroy that pressure, and a part of it would disturb that equilibrium which, by hypothesis, is the condition of the liquid in the vessel. The amount of that reaction is, of course, equal to the weight of any one of the vertical filaments comprehended between the upper surface of the liquid and a horizontal plane passing through the elementary surface pressed.

It may hence also be proved, that the pressure on the base of any vessel containing a liquid will be the same, whatever be the form or position of the sides of the vessel, provided the liquid always reaches the same height above the base. For, let A B C D be a vertical section through a prismatic vessel; the pressure on any point, a, of the base is evidently equal to the weight of the vertical filament, $b\,a$; that on any point, c, of the inclined side, B D, is the weight of the filament, $c\,d$; and this last produces no effect on the base, because the lateral pressures of all the particles in every vertical filament are counteracted by those of the particles in the neighbouring filaments. The

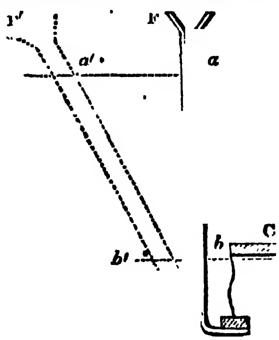
same thing must be understood of all the water in the portion E B D. The pressure on any point, *e*, under the inclined side, A C, is equal to the weight of the filament, *e f*, together with the pressure arising from the reaction of the side A C at *f*, in the vertical direction, *f e*; and this reaction is, from what has been said, equal to the weight of a filament which may be supposed to exist above *f*, with a height equal to *f g*. Consequently, the pressure on A B, when the sides of the vessel are inclined to the horizon, will be equal to that upon the same base when the sides



are in vertical positions. This is the foundation of a popular experiment, when columns of water of equal height, in cylindrical and conical vessels having equal bases, but of course containing very different quantities of the fluid, are shown to be *in equilibrio* with one and the same weight applied to prevent the movable bases from descending.

It may readily be inferred from these statements that the pressure on the base will be equal to the weight of a vertical prism or cylinder of the liquid, whose base is that of the vessel, and whose altitude is that of the liquid which it contains, whatever be the form or inclination of the sides.

On the same principle may be explained the hydrostatic paradox. In this experiment is employed a cylin-



drical machine formed of two circular plates of wood, as A B and C D, with sides of leather like those of a pair of bellows. A tube, F E, is inserted in an orifice near the bottom, and through this tube water is poured into the cylinder, till the boards, A B and C D, are at any distance asunder within the limits allowed by the leathern sides. Then if any weight be placed on the board, C D, it will cause the water to rise in the tube, E F, to a certain height, suppose *a*; and the weight of the small column, *a b*, of water may be considered as holding *in equilibrio* the weight imposed on C D; which will, in fact, be found to equal that of a cylinder of water whose base is the area of the board C D, and whose height is equal to *a b*.

If the tube, E F, were made to decline from the vertical so as to take any oblique position, E F', it would follow, since the pressure of a liquid by gravity depends on the vertical height only of the column, that the liquid in the tube, from the same pressure on C D, would rise till its upper surface is in a horizontal plane, *a a'*, passing through *a*; and the weight of the column of liquid must be estimated by the area of the horizontal section at *b'*, multiplied by the vertical height of *a'* above *b'*.

The pressure exerted by a liquid against the side of a vessel containing it, or against a surface immersed in it, whether that side or surface be plane or curved, is, by the theory of parallel forces, equal to the weight of a column of the liquid having the surface pressed for a base, and the distance of the upper surface of the liquid from the centre of gravity of the former surface for its altitude. By this theorem the pressure of water against the walls of reservoirs, lock-gates, &c., may be determined, and the relation ascertained between the weights of the liquid in vessels of various forms and the pressures against the sides.

The centre of pressure in any surface subject, like the side of a vessel containing a liquid, to the hydrostatical pressure of the liquid, is that point at which, a force being applied in a direction contrary to that of the pressure, the surface will be kept *in equilibrio*; and in all cases, when the surface pressed is symmetrical on each side of a line joining the centres of gravity and pressure, the latter coincides with the centre of percussion in mechanics.

When a triangle in a vertical position is pressed by a liquid, its vertex coinciding with the upper surface of the latter and its base being horizontal, the centre of pressure lies three-fourths from the vertex. And when a circle in a vertical position is so pressed, its upper part just touching the surface, the distance of the centre of pressure from that part is equal to five-eighths of the diameter.

The equality of the pressures in every direction at any point in a liquid mass is the cause why, if a solid body be immersed in a liquid, the pressure of the liquid immediately under it will tend to raise the body upwards with a force equal to the weight of the liquid it displaces. But the weight of the body is a force acting vertically from above downwards, and consequently in an opposite direction to that of the reaction of the liquid. Since, therefore, the volumes of the body and of the displaced liquid are equal to one another, if their weights or densities should be equal, the body would remain *in equilibrio* in whatever situation it were placed in the liquid. But should these weights or densities be unequal, the body would make an effort to ascend or descend, according as its density is less or greater than that of the liquid; and in order to counteract these tendencies it would be necessary to use a force equal to the difference between the weight of the body and of the displaced liquid. Hence, if a solid body be weighed in a liquid it will be found that its weight, compared with that of the same body *in vacuo*, will be less than in the latter case by the weight of an equal volume of the liquid; and consequently, when a body is weighed in a liquid, as water, the true weight, or that which would be obtained *in vacuo*, will be found by adding to the observed weight that of an equal volume of the liquid.

When a body floats in a liquid, in order to bring its upper surface to coincide with that of the liquid, it must evidently be loaded with a weight equal to the difference between the weight of the body, or of the displaced liquid, and the weight of a volume of the liquid equal to that of the whole body. The weight which a floating body will thus bear is denominated the buoyancy of the body; and on the principle here stated depend the common rules for finding the buoyancy of rafts, vessels, &c.

If a solid body float *in equilibrio* in a liquid, the centres of gravity of the body and of the displaced liquid must evidently be in one vertical line; otherwise the upward action of the liquid below, which necessarily has its resultant in a vertical line passing through the centre of gravity of the place occupied by the body, would produce in the latter a rotatory motion contrary to the hypothesis. This circumstance has given rise to three distinctions in reference to the equilibrium of floating bodies. If the centre of the body should be below that of the displaced liquid, the body is said to possess a stable or firm equilibrium; if above, the body is said to float with a tottering equilibrium; and if the said centres should exactly coincide, the body would float in any position whatever, and it is denominated an equilibrium of indifference.

The absolute weight of a given volume of any solid or liquid body is called its specific gravity. In this country, for convenience, it is customary to consider a cubic foot as the given volume, and to express the weight in avoirdupois ounces; thus the weight of a cubic foot of rain-water being 1000 oz., and that of a cubic foot of cast iron 7207 oz., those numbers are used to denote the specific gravities of the bodies. From this definition it follows that, when the volumes of two bodies are equal their specific gravities will be proportional to their weights; when the weights are equal the specific gravities are inversely proportional to the volumes; and in general the weights of bodies vary in a ratio compounded of their volumes and specific gravities. See SPECIFIC GRAVITY.

HYDROTHO'RAX (Gr. *hudōr*, water; and *thorax*, the chest), dropsy of the chest, is a term applied to express the existence of an effusion of serum in the pleural sac. This morbid collection may take place in consequence of inflammation of the pleura, in connection with diseases of the heart and kidneys, in scarlet fever, and in several forms of constitutional disease. It can sometimes be treated by means of diuretics and hydragogue purgatives, and in other cases the fluid may be drawn away by means of the trocar and canula, an operation which may be repeated as often as the accumulations render it necessary.

HYDROUS SILICA is another name for OPAL, which is an admixture of crystalline and amorphous silica.

HYDROZO'A is one of the great classes into which the subkingdom CŒLENTERATA is divided. This class contains the fresh-water polyps (Hydra), the Medusæ or jelly-fishes, the Portuguese Man-of-war, the Sertularians, and other forms which have no common English name. The Hydrozoa are nearly all marine forms. Some are free-swimming, others are fixed during a period or throughout life. Many form elaborate colonies, in some of which the individuals are remarkably differentiated to perform certain functions for the good of the community.

The Hydrozoa, though often extremely complex in external form, present a great simplicity of ultimate structure. The body is soft and gelatinous. It consists essentially of a mouth leading directly into the body-cavity, in which the process of digestion is performed. The substance of the body is composed of two layers of cells, *endoderm* and *ectoderm*. The ectoderm is a protective layer lining the whole of the outer surface of the body. The free surface of the endoderm lines the body-cavity. The endoderm is separated from the ectoderm by a structureless lamella, sometimes called *mesoderm*, which is greatly developed in the jelly-fish, forming the "jelly" of those animals. In the region near the mouth the body is produced into tentacles, which are composed of both endoderm and ectoderm. Into the tentacles the body-cavity originally extends, but in some cases it is obliterated, so that these organs become solid. Scattered in and between the large cells of the ectoderm are small cells (nematocysts or thread-cells), which contain coiled up a fine long thread which is sometimes provided with three barbs at the base. On pressure or irritation the thread is projected, and produces a benumbing or paralyzing effect on their prey.

Throughout the Hydrozoa, generally speaking, two distinct forms appear in the life-history of every member of the group, the "hydriform person" or polyp, resembling the common HYDRA, and the "medusiform person" or jelly-fish, resembling the common MEDUSA. Fundamentally the hydriform person consists of an elongated sac-like body with tentacles disposed round the mouth, and fixed at the extremity remote from the mouth. The polyps are generally united into a branched or tree-like colony, originating by budding from a single hydra-form, the direct product of an egg. The surface of the body may be naked or may be provided with a chitinous covering (*perisarc*) of the nature of a cuticle, formed by the ectoderm; this cuticle may be drawn up so as to form little cups (*hydrothecæ*) surrounding each polyp, into which the body can be retracted. The general histology of the hydriform person is similar to that of Hydra. In several of the marine polyps some of the muscular processes of the large ectodermal cells become separate cells. The hydriform persons present no trace of nervous system nor of sense organs. Instead of developing generative products, the polyps almost without exception produce, either by budding or by a peculiar method of transverse division, medusiform persons.

The typical medusiform person has a hemispherical body with the mouth at the end of a cylindrical process (*manubrium*), which hangs down from the centre of the concave surface of the body like the clapper of a bell or a thick handle of an umbrella. The clear dome-like disc is called the umbrella. Usually the medusiform person is solitary and free-swimming, by means of expansion and contractions of the disc. The Medusæ are transparent, thick, and fleshy; this is due to the enormous development of a gelatinous substance between the ectoderm and endoderm, similar to the structureless lamella of the polyps. This gelatinous substance or "jelly" is usually structureless, but in some cases contains fibrous bands, which hold in their meshes wandering endoderm cells that possess amœboid movements. In consequence of the great development of this jelly the body-cavity has been encroached upon, and more or less pinched into the form of canals. There is always a marginal canal running all round the edge of the disc, and continued into the hollow tentacles. There are also radial canals running from the digestive cavity to the marginal canal. There may also be other canals running into the fleshy disc, and an endoderm lamella, a layer of endoderm cells, formed by the obliteration of the cavity and the union of the walls. The space between the margin of the disc and the mouth-stalk or manubrium is known as the *sub-umbrella*. The margin of the disc is usually turned in to form the *velum*, which is a muscular contractile flap, serving to contract the sub-umbrella space and expel the water therefrom: in this way the jelly-fish is driven along vigorously through the water, mouth downwards. The margin of the disc is provided with tentacles, sometimes numerous, forming a fringe, sometimes four or six in number. The mouth is surrounded by numerous tentacles, or sometimes by long finger-like processes. Nerve-fibres and ganglion-cells are found in Medusæ. Organs of sense are also present, arranged along the margin of the disc. Three distinct kinds are found in different Medusæ: eyespots, in which pigment is present; otocysts or auditory organs, small oval bodies containing calcareous matter; and tentaculocysts, which are modified tentacles functioning as auditory organs. Generative products are produced by the Medusæ.

The relationship between these two distinct forms, the polyp and the jelly-fish, is explained by Professor Ray Lankester in the following way:—"A simple shortening of the vertical axis, and a widening of the hypostome (mouth region), with obliteration of the lumen (but not of

the cells) of the endoderm over a considerable region of the disc thus produced, suffice to convert the hydra-form into the medusa-form. This change of proportion made, the sense organs of the medusiform person have to be added, and the change is complete. Thus it becomes clear that we have to deal with one fundamental form, appearing in a lower, fixed, nutritive phase, and a higher locomotor generative phase in the two cases respectively."

The class Hydrozoa is divided into two well-marked subclasses, Hydromedusæ and Scyphomedusæ. The subclass Hydromedusæ is the most numerous. In this group the hydriform person is a simple elongated polyp, with an indefinite number of tentacles surrounding the mouth. It frequently gives rise by lateral gemmation to a colony, on which the medusiform persons are produced. The medusiform persons sometimes develop straight from the egg, the hydra-form being suppressed. They always have a complete velum, and the nervous system arranged in a continuous ring, around the margin of the umbrella; and differ from the hydra-forms in being sexually mature. On some of the colonies the Medusæ, after being produced by budding and attaining their full development, break off and swim away. In other cases the whole colony is free-swimming, the Medusæ taking upon themselves the locomotion of the entire community. Again, the Medusæ may remain fixed upon the colony in a modified degenerate form, existing merely for the development of the generative products. Every stage in this degeneration is found, from the ordinary medusa-form with reduced manubrium to forms in which the mouth of the bell is closed by the union of the margins of the disc and traces of the typical internal structure are gradually lost. Even the ovary and testis of the common hydra are regarded by some as very much reduced medusiform persons.

The first order of the Hydromedusæ is Gymnoblastea-Anthomedusæ. In this order both hydriform and medusiform persons are found in the life-history of every species, but the medusa-forms are often very degenerate. In the polyp-form the chitinous perisarc, if present, never reaches further than the crown of tentacles. The complete medusiform persons have eyespots at the base of the tentacles and the generative products developed on the sides of the manubrium. Rarely Medusæ are produced by budding from other Medusæ. One genus (Hydra) in this order is solitary, and the medusiform person is reduced to a mere wart on the body of the polyp. Usually a colony is formed, the persons being either developed from a common creeping base, or forming a tree-like growth. In some genera there is seen the beginning of that differentiation of persons which obtains to such a remarkable degree in the free-swimming oceanic colonies (Siphonophora). In a colony of Hydractinia two modifications, besides the ordinary form, of the hydriform person are found—the *blastostyle*, carrying a cluster of modified medusiform persons or generative buds; and the *dactylozooid*, an elongated polyp with reduced tentacles, situated at the margin of the colony, and acting as a tentacle. *Hydractinia echinata* is often found on our coasts on shells. Tubularia (Plate I. fig. 1) is also found in British seas, forming very beautiful colonies.

The second order of Hydromedusæ is Calyptoblastea-Leptomedusæ. The persons are collected into stationary colonies. The common stalk of the colony is clothed with a horny covering (perisarc), which forms little cups (hydrothecæ), into which the body of the polyps, tentacles and all, can be retracted; it also forms a horny case (gonangium), in which is inclosed the blastostyle carrying the generative buds or aborted Medusæ. The fully developed Medusæ may have otocysts in addition to eyespots. According to Allman these Medusæ produce not generative products, but a series of generative buds, which are situated on the radial canals. The Plumularians (Plumularidæ) belong to this order. In this family (see Plate, fig. 2) the hydrothecæ are sessile and placed all on one side of the branch. The Sertularians (Sertularidæ, fig. 3) have sessile hydrothecæ placed alternately on either side of the branch. The colonies are known as Coralline, and are common on seaweeds, &c., on British coasts. The family Campanularidæ (fig. 4) has stalked hydrothecæ.

In the next two orders, Trachomedusæ and Narcomedusæ, no hydriform person is known. In Trachomedusæ the development from the egg straight to the medusa-form has been observed in one genus (Geryonia); all the members may have a similar history. The sense organs are in the form of tentaculocysts, on which eyespots may be present. The gelatinous substance of the disc is hard and stiff, and the tentacles are sometimes rigid. In Geryonia (fig. 5) a portion of the disc is drawn out to form a long column, at the end of which is the manubrium and mouth. The only known fresh-water medusa (*Limnocodium Sowerbii*), found in the summer of 1880 in a tank in the Botanic Gardens, Regent Park, London, belongs to the order Trachomedusæ. A polyp-form has been recently (December, 1884) found in connection with this medusa, and is considered to represent the hydriform phase in its life-history. In the order Narcomedusæ the development from the egg into a medusa has been observed in Ægina and Æginopsis.

The fifth order of Hydromedusæ, Hydrocorallinæ, is remarkable for producing colonies built up of modified individuals disposed in a definite system. The Hydrocorallinæ assist in the production of coral-reefs. From a common calcareous base arise modified polyps of various kinds, long dactylozooids surrounding a *gastrozooid*, a short flask-shaped mouth-bearing polyp. Two families are distinguished, the Millepores (Milleporidæ) and the Stylasters (Stylasteridæ). In the latter family the medusiform persons exist in a degenerate state, inclosed in little swellings (ampullæ) on the calcareous base. In the Millepores the medusiform persons are unknown.

The last order of Hydromedusæ is Siphonophora, forming large swimming colonies on the surface of the ocean. In this order the differentiation both of the hydriform and medusiform persons has proceeded to an extraordinary degree. Physophora (fig. 6) has a number of persons arranged vertically on a common stalk, the base of which forms an air-sac (*pneumatocyst*). The persons immediately below the air-sac are modified Medusæ, the swimming bells (*nectqcalyces*), by the contraction of which the colony is propelled through the water. Next come dactylozooids, alternating with gastrozooids with mouths and long tentacles and small medusiform persons carrying the generative products. The colony of Rhizophysa (fig. 7) is similarly constructed. In the genus Physalia (fig. 8), the Portuguese Man-of-war of the tropical seas, the stalk is converted into an enormous bladder-like float. Swimming bells are absent. Beneath the float are dactylozooids, gastrozooids, generative persons, and numerous long tentacles. In the genus Diphyes (fig. 9) the air-sac is not developed. The persons are united by a long thread-like unbranched stem. There are two large swimming-bells, into which the other persons can be retracted. These others are arranged in groups along the stem, each group consisting of a gastrozooid with a long tentacle, generative persons, and covering-pieces (*hydrophyllia*). Velella (fig. 10) has the stem converted into a flattened raft-like disc, upon which stands an obliquely placed cartilaginous sail (air-sac), projecting out of the water. Below the disc are generative and nutritive persons, one gastrozooid being usually large and central in position; on the edge of the disc are dactylozooids. The generative persons (blastozooids) detach themselves and swim away as ordinary Medusæ.

The subclass Scyphomedusæ (Plate II., figs. 11–18) presents well-marked distinctions both in its hydriform and its medusiform persons from Hydromedusæ. The hydra-form

of Scyphistoma is broader and shorter than in Hydromedusæ. It has sixteen tentacles definitely arranged, and four deep ridges on the wall of the digestive cavity. The medusiform person has no true velum. Sense organs are, in the form of tentaculocysts, sunk in notches of the disc. The nerve-fibres and ganglion cells are not arranged in a continuous ring, but are scattered. The generative products, only produced by the medusiform persons (except in Lucernaria), are developed from the endoderm. The Medusæ are sometimes developed straight from the egg, but more usually from the hydra-form, which undergoes a peculiar process of transverse division. In the common medusa (*Aurelia aurita*) the embryo, emerging from the egg, develops into a ciliated free-swimming spherical organism (planulâ), which attaches itself to some foreign body, as a rock or seaweed, and acquires a mouth and tentacles. Meanwhile the body elongates, and a series of constrictions appear extending transversely across the body from a little below the tentacles to a little above the fixed extremity. The constrictions deepen till the Scyphistoma has the appearance of a set of saucers piled one upon another, the top alone having a circlet of tentacles. In some cases the tentacles are redeveloped below the last constriction. The pile now breaks up, the top falls away and dies, the bottom remains fixed, while the other discs swim away and become perfect Medusæ. When liberated from the Scyphistoma the young medusa (called *ephyra* at this stage) is somewhat star-shaped, having eight arms, into each of which extends a process of the alimentary canal. In a depression in each arm is placed a tentaculocyst. In the notches between the arms appear eight tentacles. The space between the arms gets filled up, and a fringe of tentacles is developed on the margin.

The first order of Scyphomedusæ is Lucernarida, in which the Scyphistoma stage is permanently retained, developing its own generative products. The Lucernaria can detach itself and swim by contractions and expansions of its body. The order Discomedusæ contains the large oceanic jelly-fish. *Aurelia aurita* (fig. 11) is the common jelly-fish. It has the mouth provided with four arm-like processes, which hang down when the disc is in motion. The generative products are developed on the walls of the digestive cavity. Round the mouth are small openings, the so-called subgenital pits. Rhizostoma (fig. 13) has eight processes to the mouth, which grow together and obliterate the original opening, leaving only a number of small passages into the digestive cavity. Some of the Discomedusæ develop straight from the egg. The principal family in the order Cubomedusæ is Charybdæidæ. Charybdæa is remarkable for its simplicity of organization in some respects. It agrees with the Hydromedusæ in having a continuous nerve-ring. It has a kind of velum, into which the canals of the digestive system run. The umbrella is somewhat quadrangular, with four long tentacles depending from the corners of the margin. Another order, Peromedusæ, has been founded by Häckel for some Medusæ discovered in the deep sea by the *Challenger* expedition.

The Ctenophora (three of which are shown in Plate II., figs. 14–16) appear in the light of the researches of Häckel to be nearly allied to the Hydromedusæ, through such forms as the recently described medusa, Ctenaria.

(For this article we are mainly indebted to the writings of Professor Ray Lankester.)

HYDURIL'IC ACID, an acid obtained from uric acid by oxidation. It forms a colourless crystalline powder, slightly soluble in cold water and alcohol, but more so in boiling water, from which it crystallizes on cooling. It is soluble in sulphuric acid, without decomposition. The formula is $C_8H_6N_4O_6$. It gives a dark-green colour to solution of ferric chloride. It forms a number of definite crystalline salts called hydurilates, and also a chlorinated acid called dychlorohydurilic acid ($C_8H_4Cl_2N_4O_6$).

HYETOL'OGY or **HYETOM'ETRY** is that branch of meteorological science which investigates the quantities and modes of precipitation of water in any form from out the atmosphere. The full account of Fog, Mist, and cloud; of Rain, Snow, and Hail; of Verglas, Dew, and Hoar-frost, comes under this great department. The separate heads are treated of as distinct articles. Hyetometry is the exact converse of *atmometry*, a term used to connect the various investigations of the absorption of water in various forms by evaporation into the atmosphere, whether from surfaces of water, ice, or snow, or from substances in the act of drying. The consideration of the amount of moisture present at any time in the air is called Hygrometry.

HYGE'A, more correctly *Hygieia* (Ὑγίεια), the Goddess of Health in the Greek mythology, was a daughter of Æsculapius, the god of the healing art—a manifest allegory. The worship of father and daughter was usually coupled at the same temple, as at Athens, Argos, &c. Her statues show a young smiling female form, fully draped, and holding a serpent as emblem of renewal of youth and strength. The serpent, as it issued fresh and apparently as young as ever from out its old cast-off skin, seemed to the ancients to enjoy a power of rejuvenescence, and was sacred accordingly to the god of medicine and the goddess of health. Often Hygea feeds her serpent from a patera or flat cup.

The name is very frequently spelt *Hygeia* by writers of our own day in the more scholastic works on sanitary matters, but there seems no authority for this peculiar orthography. *Hygia* is, however, found as a third form used by the ancients.

HYGIENE, pronounced *hygeen'* (Gr. *hugieinos*, good for the health), the art of preserving health, and the name given to that department of medical science which seeks to prevent disease and to maintain the most perfect action of body and mind consistent with the laws of nature. The study of hygiene deals with man in his individual capacity and in his social relations, and includes within its scope an immense variety of subjects. The tendencies derived from parents and more remote ancestors; those which are peculiar to the different stages of life, from infancy to old age; the effects of diet, air, exercise, cleanliness, the action of the mind upon the body and of the body upon the mind, have all to be considered as they affect personal health. In connection with public health the science deals with the sites of cities and villages, the arrangement and construction of dwellings, water and food supply, the removal of sewage and waste products, the regulation of trades and manufactures, the arrest of infectious disease, the disposal of the dead, and the collection and publication of health-statistics. In all the departments indicated much good work has been done by scientific observers, both in England and on the Continent, and many important reforms in the management of public affairs have been introduced. The progress of the science in its practical aspects is, however, greatly retarded by ignorance and indifference upon the part of legislators, local authorities, and the public generally, and also by the selfishness of most persons who are connected with such vested interests as thrive by the present unsatisfactory condition of things. Such hindrances can only be removed by the spread of knowledge upon this subject, and happily there is now a plentiful supply of information available. See the valuable work of Dr. Parkes, "The Manual of Practical Hygiene," and "Public Health," by the same author.

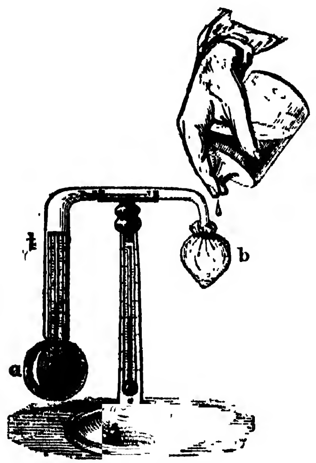
HY'GRINE is an organic base found with cocaine in coca leaves (*Erythroxylon Coca*), natural order Erythroxylaceæ. It is a yellow oily body, strongly alkaline, soluble in water, alcohol, and ether, and forming salts with acids. Cocaine, the other alkaloid, is crystalline, and is bitter to the taste. It melts at 98° C. (208° Fahr.), is slightly soluble, but very soluble in alcohol and ether. The formula

is $C_{16}H_{19}NO_4$. It forms a number of crystalline salts with acids.

HYGROM'ETRY is that part of natural philosophy which relates to the determination of the humidity of bodies, particularly of the atmosphere; it comprehends also the theory of the instruments (*hygrometers*) which have been invented for the purpose of ascertaining the quantity of water contained in a given volume of air.

The water received from the earth is not dissolved in the atmosphere—it exists there in the form of visible or invisible vapour. The quantity of vapour contained in a portion of the atmosphere depends greatly upon the temperature of the latter, and it is extremely variable even when the temperature is constant. When a quantity of aqueous vapour at a given temperature is diffused through any space it will support the same external pressure, whether that space had previously been void or occupied by air. On these principles are founded the methods which have been used for determining the absolute quantity of moisture in a given volume of air by means of the hygrometer, the requisite data being the elasticity of aqueous vapour at different temperatures, and the corresponding indications of the instrument.

The hygrometer of M. De Luc was a thin slip of whalebone, whose contractions indicated the variations of moisture; and De Saussure had recourse to a human hair, by means of which he constructed a far more delicate instrument, which was, however, exceedingly liable to derangement, and, unless prepared with extraordinary care, was uncertain. A very ingenious instrument was also invented by Leslie. These instruments are still used for rough approximations, but usually under the name of HYGROSCOPE. The term hygrometer is now limited to those accurately scientific instruments, the first type of which the late Professor Daniell introduced. It consists of two thin glass balls, 1¼ inch in diameter, connected by a glass tube about 7 inches in length. The tube is bent in two



Hygrometer.

places at right angles, so as to form three arms of unequal length, the longest of which contains a small thermometer, *t*, whose bulb descends into the lower of the two glass balls, *a*. This ball, after being about two-thirds filled with ether, is placed over a spirit-lamp until the vapour of the ether has expelled the contained air through a capillary tube, which is left open for the purpose, and afterwards hermetically sealed. The other ball is then covered with a piece of muslin, *b*, and the instrument thus adjusted is placed upon a stand, to which is attached a small thermometer indicating the temperature of the external air. When about to be used a small portion of ether is poured upon the muslin, which, by evaporating, lowers the temperature of the glass ball, and thereby occasions a rapid condensation of the ethereal vapour contained within the instrument. The condensation of the vapour within the tube produces a continuous evaporation from the surface of the ether in the lower ball, whereby the temperature of the included ether is continually reduced, until a deposit of moisture from the surrounding atmosphere is observed to take place upon the exterior of the glass. At this instant the inner thermometer, which always indicates the temperature of the ether, is observed, and thus the dew point, or that at which the precipitation of atmospheric moisture takes place, is determined with considerable accuracy. Having ascertained the dew point, and likewise the temperature of the external air, the actual quantity of moisture contained in the cubic foot of air will readily be found from the formula,

$$\text{Weight in grains} = \frac{5656 \cdot 2}{448 + t} \times p,$$

where *t* denotes the temperature of the external air, and *p* the elasticity of aqueous vapour at the temperature indicated by the interior thermometer. The value of *p* for every degree of the thermometer is given in the tables of the expansive force of steam. This instrument, so excellent in theory, is very costly, on account of its great consumption of ether, and can scarcely be used in hot climates, owing to the difficulty observed in preserving that liquid. It is also objected to because an experiment has necessarily to be made to obtain an observation. It was employed for the determination of the dew point at the Royal Observatory, Greenwich, from 1840 to 1847, but since that period it has been superseded by the more convenient instrument —the wet and dry bulb hygrometer. This instrument consists of two thermometers—an ordinary one, to give the temperature of the air; and another, whose bulb is covered with a piece of muslin or other similar material, to which is attached an absorbent wick, communicating with a vessel of rain-water—an arrangement by which the muslin is kept constantly wet. The evaporation from the muslin and consequent cooling of the bulb being in proportion to the dryness of the air, the difference between the readings of the two thermometers will be greatest when the air is driest, and zero when it is completely saturated with moisture. The reduction of the observations to find the elastic force of vapour at the dew point is effected by the formulæ of Dr. Apjohn:—

$$(1)\ F = f - \frac{d}{88} \cdot \frac{h}{30}; \quad (2)\ F = f - \frac{d}{96} \cdot \frac{h}{30},$$

(1) to be used when the reading of the wet thermometer is above 32°, and (2) when below. In these formulæ F is the elastic force of vapour at the dew point; *d* the hydrometric depression, or depression of the dew point; *h* the height of the barometer; and *f* the elastic force of vapour for the temperature shown by the wet thermometer. In these calculations Glaisher's "Hygrometrical Tables" will be found of very great value, as they include all the requisite data and corrections.

In Great Britain the mean evaporation per minute from each square inch of the surface of water is 0·01155 grain. The method at present adopted at the Greenwich Observatory in all hygrometrical observations is by means of the wet and dry bulb thermometer, as described above; but in a work on the subject by Sir John Herschel, he states that "it cannot be denied that great difficulty still exists in determining, by any mere reading of instruments, the exact hygrometric state of the air." Since 24th August, 1856, hourly hygrometrical observations have been made at the observatory once in every week during twenty-four hours, the deductions from which, stated for each hour,

include also that of the vapour required to saturate a cubic foot of air. They are also given, with the other meteorological elements, in the form of monthly returns.

HY'GROSCOPE, any instrument which serves in a rough manner to indicate the greater or less moisture of the air, but without the proper scientific accuracy of the *hygrometer*. [See HYGROMETRY.] The most common form of hygroscope is that made of twisted catgut, the greater humidity of the air causing the strands to thicken and shorten the whole length, and a return to comparative dryness restoring the catgut to its original length. Such a piece of catgut properly adjusted to a balance rod will cause a figure on one end of the rod to appear in damp weather and to disappear in fine weather, giving place to a companion figure which now triumphantly issues. A chimney ornament which amuses simple folk is thus easily made, though it would be hard to find much usefulness in it as a weather indicator, since it follows the state of the air instead of predicting it. A long broad leaf of seaweed, to which a small weight is hung, serves also as a hygroscope, lengthening in damp weather through the affinity for moisture possessed by the salt which still thinly coats it. A hair will serve as even a more delicate hygroscope, and may be made to move a balanced needle over a graduated quadrant, as in Saussure's hygrometer, but its accuracy is not nearly sufficient to entitle it to this latter name.

HYK'SOS (that is, *Shepherd Kings*), two of the ancient dynasties of Egypt, namely the fifteenth and sixteenth, the first beginning to reign in B.C. 2101, as the result of a sudden invasion of the highly civilized land of the Pharaohs, which we can reasonably compare to the overrunning of the Roman Empire by the Goths or the Huns. The sixteenth dynasty and the seventeenth were contemporaneous, for the latter was composed of local princes of Upper Egypt distinct from, but tributary to, the Hyksos, who ruled from Memphis. Finally, in B.C. 1591, Aahmes, one of these subkings, led a great revolt, and the barbarian yoke was shaken off for the magnificent period of the "Empire," Egypt's culminating point of splendour and power. Josephus seems to try to confuse the Hyksos (who were undoubtedly Semitic in race) with the Israelites, since he asserts that they founded Jerusalem. But what seems much more probable by the latest discoveries is that Abraham lived in Egypt under the fifteenth and Joseph in the sixteenth dynasty, that is, under these Hyksos kings, and the exodus may therefore have taken place towards the close of the period.

HY'LAS, a beautiful youth beloved by Herakles, who landed at Kyzikos (Cyzicus) in the Argonautic expedition to help Herakles to cut a new oar to replace one which he had broken. The two were separated in the search for a suitable bough, and some Naiads seeing Hylas seized him for his beauty, and bore him away to the springs where they dwelt. The great hero searched for his friend as soon as he missed him, and refused to return to the Argo without him. The great expedition therefore sailed on its way without Herakles. In the end the hero heard a faint reply to his shouts, and this was the voice of Hylas trying to reply to him from the Naiad's home beneath the waves. This was one origin of the echo given by the Greek mythology, but it never attained the poularity of the more famous tale of Echo and Narcissus.

HY'LOMYS is a genus of Insectivora, usually classed with the Bangsrings (Tupaiidæ). One species only is known, *Hylomys suillus*. This rare little animal was discovered by Dr. S. Müller inhabiting the islands of Sumatra and Java, and living at a height of from 1200 to 2000 feet above the level of the sea. In the form of the skull and other cranial peculiarities it appears to approach the Tupaiidæ; but the skull is flatter and the back of the orbit is not closed in by a bony ring, such as is found in that family. Its affinities with the aberrant Bulau (*Gymnura rafflesii*) are very striking; Professor Flower, indeed, places it in the same genus under the name *Gymnura suilla*. In its dentition it agrees with Gymnura, having forty-four teeth, twelve incisors, four canines, sixteen premolars, and twelve molars. The snout is prolonged forwards into a movable proboscis, which is directed a little downwards at the tip, where the nostrils are laterally disposed. The eyes are not large; but the ears are conspicuous, and thinly provided with hair. As in the bulau, the feet have five toes, the three central digits being paramount, and the hind feet longer than the fore feet; the claws are sharp and strongly curved. The tail is particularly short, and but thinly clothed with hair. Very little is known respecting its habits. The teeth, however, indicate its insectivorous propensities.

HY'MEN or **HYMENAI'OS,** in Grecian mythology, the God of Marriage, was the son of Apollo and a Muse. In very early legends he was described as a mortal of extreme beauty, who delivered from captivity some Attic virgins who had been carried to Eleusis by Pelasgian pirates. For this service he was rewarded with a maiden of whom he was deeply enamoured; and on account of his conduct and the happiness of his marriage he was invoked in bridal songs, thence called hymeneal songs. In ancient art he is represented as a tall and elegant, but somewhat effeminate youth—a larger and more serious Eros. He usually carries in his hand the bridal torch, and sometimes wears on his head, or around his neck, a wreath of flowers.

HYMENÆA was the name of certain festivals celebrated at Athens in honour of Hymen.

HYMENÆ'A, a genus of plants belonging to the order LEGUMINOSÆ. *Hymenæa Courbaril* (locust tree, or gum-anime tree) is a fine lofty spreading tree, and grows in the tropical parts of America and in Jamaica. The seeds are enveloped in a cellular mealy substance, which is sweet like honey, and is eaten by the Indians with great avidity. When fresh it is slightly purgative, but by keeping it loses this property. A decoction of this substance, when allowed to ferment, forms an intoxicating drink resembling beer. From the principal roots of this tree there exudes a fine transparent resin of a reddish colour, which is collected in large lumps and sold under the name of gum-anime. It resembles amber, is very hard, and sometimes contains leaves, insects, or other objects imbedded in it, which remain in a perfect state of preservation. It burns steadily, emitting a very fragrant smell. Dissolved in rectified spirits of wine, it makes one of the finest kinds of varnish. In countries where this tree grows the resin is used medicinally for rheumatic complaints, and has also been employed in that way in Europe. It is taken internally in doses of a teaspoonful of the solution, and is used also externally as an embrocation. The timber of the old trees is very hard and tough, and is in great request for wheelwork, particularly for cogs. The wood is very heavy, and takes a fine polish. The genus takes its name from Hymen, the god of marriage, from the circumstance that each leaf is composed of a single pair of leaflets.

HYMEN'OMYCE'TES is a suborder of the Basidiomycetes, an order of Fungi. This suborder is characterized by the hymenium (spore-bearing surface) being in the adult state completely exposed. These fungi are generally soft and fleshy, and sometimes gelatinous. Many of them are edible, and they serve an important end in the economy of nature by rapidly decomposing dead organic matter into elementary forms of inorganic matter, which can be used up again by plants. M. C. Cooke, in his "Handbook of British Fungi," has followed Berkeley in making the following divisions:—Agaricini, those which bear gills or gill-like wrinkles; Polyporei, those with pores or tubes; Hydnei, those with spines or tubercles; Auricularini, those

with an even spore-bearing surface; Clavariei, those which are club-shaped or branched; Tremellini, substance gelatinous. The latter division has been ranked by others as a separate suborder. See FUNGUS.

The division Agaricini contains the genus AGARICUS, many of the species of which are eatable. In the same genus are included the various species of Amanita, which are among the largest and most remarkable forms of the division. *Agaricus* (Amanita) *muscarius* possesses an intoxicating or narcotic property. It is used by the inhabitants of the north-eastern parts of Asia in the same manner as wine, brandy, arrack, spruce, &c., by other nations. One large or two small fungi is a common dose for producing a pleasing intoxication, which lasts for a considerable time (see Plate FUNGUS, fig. 1). In this division is also included the genus Cantharellus, several species of which inhabit Great Britain. The *Cantharellus aurantiacus* is common in fir-woods and pastures. It has a beautiful orange colour and a strong smell. *Cantharellus cibarius* (the common Chanterelle) is frequent in woods in the summer and autumn. The pileus is of a pale yellow colour, and the whole plant has an agreeable smell, like that of apricots. On the Continent this fungus is eaten, but is not often used in Great Britain. It is dangerous when eaten raw, and should always be cooked.

Among the Polyporei the following may be taken as examples:—*Trametes gibbosa* (Plate FUNGUS, fig. 2) is a rare fungus, growing on gate-posts, stumps, &c., of a dirty white colour. *Merulius lacrymans* (fig. 3, same Plate) is the principal cause of dry-rot in timber, the mycelium penetrating and forming white layers; this fungus is reddish-yellow, large, fleshy, and generally dripping with moisture. Some species of the genus Boletus (fig. 4) are esculent.

The genus Dædalea has been so named from the remarkable sinuosities and sculpture-like pores of its hymenium. *Dædalea quercina* is found commonly on oak trees, or stumps and roots of that wood. It is an astringent, and has been applied to wounds to arrest hæmorrhage. Many species of Polyporus are used in the arts and in medicine. *Polyporus destructor* is one of the fungi found on decaying timber when it is attacked with what is called dry-rot. The genus Fistulina has one representative in Great Britain, *Fistulina hepatica* (the pipe-stool). It grows upon the trunks of old oaks and other trees, and is eaten in France.

Of the Auricularini, the species *Stereum hirsutum*, a yellow fungus, is common on oak logs; and the purple one, *Stereum purpureum*, on logs of poplar.

Hydnum is the typical genus of Hydnei (see Plate FUNGUS, fig. 5). *Hydnum coralloides* is at first white, afterwards yellowish; it is edible, but is rarely met with.

The division Clavariei in their branched and club-shaped forms resemble the corals, and were actually placed by the older naturalists in the same class. Some of the species are edible (see Plate FUNGUS, fig. 6).

HYMENOPH'YLLUM is a genus of filmy FERNS. There are two native species, one of which is well known, the Tunbridge Wells Fern (*Hymenophyllum tunbridgense*); this fern grew formerly on the high rocks at Tunbridge Wells, hence its name. Other species are found in the tropics, as well as in Chili and New Zealand. The fronds vary from simple to decompound, and are membranous and pellucid. The spore-cases are collected on the ends of veins which project from the fronds, and are inclosed by the indusium, which is two-lipped. This genus and Trichomanes are included in the group Hymenophylleæ.

HYMENOP'TERA is one of the orders into which INSECTS are divided, containing saw-flies, gall-flies, ichneumon-flies, ants, wasps, and bees. Hymenopterous insects possess four membranous wings, of which the anterior pair are the larger. They have all the usual parts of the biting mouth well developed; that is to say, they possess labrum, labium, mandibles, and maxillæ, of which the mandibles are always adapted for biting, but the other parts are often modified. Besides the ordinary compound eyes, they are furnished with three ocelli, or simple eyes, which are usually situated on the vertex of the head. Their tarsi are five-jointed. The females are provided with an ovipositor, which is in many species so organized that it can not only perform its ordinary function, but serve as a weapon of offence and defence, and is the part which in bees and wasps is called the sting; in these insects it is barbed at the apex. The mesothorax and metathorax are well developed; the prothorax is narrow, forming a ring or collar, and firmly attached to the mesothorax. The metamorphosis is complete.

The wings in repose lie one above the other on the back of the insect. In flight they are connected together in a rather curious fashion, making, as it were, one large powerful wing on each side. The hind wings are provided on their front margin with a row of hooks which fit into a groove at the hind edge of the fore wings. The wings are furnished with branching veins or nervures, the number and disposition of which in the front wings are very characteristic throughout the order, and are useful in classification. The nervure which bounds the front margin of the wing is called the costa (*a*); just below and parallel runs the subcostal (*b*) nervure, these two uniting usually beyond the middle of the front margin to form a thickened horny spot, the stigma (*st*). The space between the costa and the subcostal nervure forms the costal (1) cell. From the stigma the radial (*c*) nervure runs to the tip of the wing, meeting the costa on the front margin, and inclosing the marginal (2) cell. Another nervure runs along the middle of the wing from the base, sending a branch up to the subcostal, which branch gives off a nervure which runs to the apex of the wings; the spaces between this nervure and the marginal cell are usually divided by cross nervures into the submarginal (3–6) cells. Cross nervures, the recurrent nervures, run back from these cells to the original main nervure, inclosing the discoidal (7–9) cells. The venation of the wings is most developed in the Saw-flies (Tenthredinidæ); every degree is found, from this condition to that which obtains in Chalcididæ, in which the wings are almost destitute of venation. The wings are often absent, sometimes in both sexes, but frequently only in the females. In the ants the neuters (undeveloped females) are wingless, while the females shake off their wings after pairing. The antennæ vary greatly in form; they are often long and thread-like, tapering or provided with a distinct club: sometimes they are setaceous. The abdomen is united to the thorax by its entire breadth, or more usually by a slender stalk. The ovipositors of the females are appendages of the terminal abdominal segments. The ovipositor generally consists of five parts, the two outer forming a sheath; the other three parts are bristle-like organs, the principal one being placed above and deeply grooved along its lower surface, while the other two form slender lancets, and are pressed against it so as to form a canal, through which the eggs pass. When the ovipositor is converted into a sting its base communicates with a gland secreting an acrid fluid, the chief constituent of which is formic acid. Many of the suborder Fossores lay up a store of insects in their nests, so that the larvæ on emerging from the egg may find abundance of food ready at hand; in many cases these insects are not killed

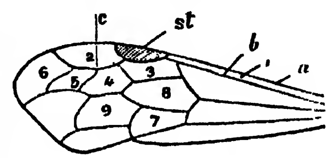
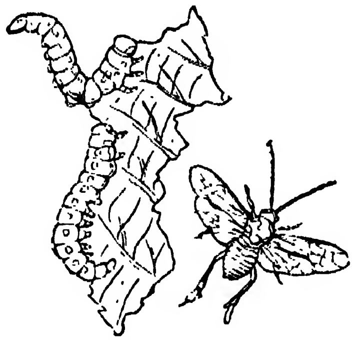


Diagram of Front-wing of Hymenoptera.

outright, but are paralyzed by a severe sting. In the saw-flies the ovipositor is converted into a saw, by means of which the female makes slits in the shoots of plants in order to deposit her eggs.

Insects of the order Hymenoptera undergo what is termed complete metamorphosis, *i.e.* the larva is unlike the perfect insect, and the pupa does not possess the power of locomotion. The larvæ of the saw-flies and



Saw-fly (Tenthredo) and Larvæ.

wood-borers very much resemble those of the order Lepidoptera (butterflies and moths), but differ in the number of their legs, &c. The larvæ, however, generally speaking, are destitute of legs, and do not possess a distinct head, and these are for the most part fed by the parent insect, or, as in the case of bees and wasps, by the neuters. In other cases the larvæ are hatched within the bodies of other insects, and feed on the tissues of their hosts. GALLS are produced by the gall-flies (Cynipidæ) and by some saw-flies; they originate from the puncture made by the ovipositor in leaves, stems, and roots, the tissues of which provide the larvæ with food. The larvæ with legs have three pairs of thoracic legs and a variable number of abdominal pro-legs. In all cases the larvæ have traces of legs while still within the egg; from this it is conjectured the present legless condition of the larvæ which generally obtains in this order is not original, but results from disuse owing to the larvæ not having to provide their own food. The larvæ are provided with silk-glands for secreting the silk, with which many of them spin themselves a cocoon before entering on the pupal condition. In the pupæ all the parts of the perfect insect are visible, since they are inclosed only in a delicate semi-transparent membrane.

In the imago, or perfect state, most hymenopterous insects live upon flowers, or at least often frequent them, some for the purpose of gathering honey, and others find them a convenient resort wherein they may prey upon the less powerful species of their own class.

Intellectually the Hymenoptera stand high; the ants and bees indeed are ranked by some next to man himself in the scale of intelligence. The social habits of ants, bees, and wasps are detailed in the special articles devoted to them. These insects enjoy a refined kind of communism, which proceeds so far as to lead to the modification of individuals to fit them to perform certain duties for the good of the community. The society, into which the individual is thus completely merged, contains at least one specialized form, the workers or neuters, which are undeveloped females. These workers among the bees have to provide for the wants of the community and nurse the young, while the perfect female has only to lay eggs; the males are drones, and after the fertilization of the queen-bee are massacred by the workers as mere useless mouths. Among the ants several kinds of workers are differentiated, one kind having the jaws enormously developed; these form a standing army of soldiers. Parthenogenesis, or virgin reproduction, is common among the Hymenoptera. Males are unknown in some species, and extremely rare in others. An alternation of generations takes place among the gall-flies.

The Hymenoptera are the most useful of all insects to man. Apart from the direct benefits we derive from wax, honey, and ink, of which latter galls form an ingredient, the indirect advantages from the ravages of the parasitic ichneumon-flies on destructive caterpillars are inestimable. These insects are not, however, an unmixed good. In our own country the saw-flies are very destructive to fruit-trees, while in the tropics ants become a perfect plague.

The Hymenoptera are nearly all of small size. They are almost world-wide in their distribution. The number of described species is over 17,000, but the total number is probably four or five times as great. There are about 3000 British species.

The Hymenoptera may be divided into two great divisions: Aculeata, in which the ovipositor is converted into a sting and the trochanter is joined to the femur by a single joint; and Ditrocha (or Terebrantia), in which the ovipositor is never a weapon of offence and the trochanter consists of two rings. The Ditrocha are divided into three suborders, TEREBRANTIA, PUPIVORA, and TUBULIFERA. The Terebrantia (or Securifera) contain the saw-flies, Tenthredinidæ (Plate, fig. 2), and the tailed wasps or borers, Siricidæ (fig. 1). The ovipositor is either a saw or a borer; the larvæ have legs; vegetable substances form the food of this suborder. The Pupivora (or Entomophaga) are distinguished by having the abdomen attached by a stalk. They feed on insects, on which they are often parasitic. This suborder includes the ichneumon-flies, Ichneumonidæ (figs. 3, 4), Evaniidæ, (fig. 5), Prototrupidæ, Chalcididæ, and the gall-flies (Cynipidæ). The suborder Tubulifera includes only one family, Chrysididæ, remarkable for having the posterior segments of the abdomen retractile. The division Aculeata also falls into three suborders, HETEROGYNA, FOSSORES, and MELLIFERA. The suborder Heterogyna contains the ants (Formicidæ), distinguished by having two kinds of wingless workers. Fossores are distinguished by their carnivorous burrowing habits; they are not social. This suborder includes Mutillidæ (fig. 6), Scoliidæ (fig. 10), Bembecidæ, Crabronidæ (fig. 11), the sand-wasps, Sphegidæ (figs. 8, 9), and Pompilidæ. The true wasps, Vespidæ (fig. 7), often placed in this suborder, must be separated under the name Diploptera; some of them are social, and the wings are folded longitudinally in repose. The suborder Mellifera contains the bees.

HYMET'TUS (Gr. *Humettos*) is the ancient classical name for a mountain in Attica, famous especially for its thymy slopes, or rather for their product in the shape of honey, and for the marble quarries worked on its flanks. Its modern name is Trelovouni, and it lies a little to the south of Athens.

HYMN (Gr. *humnos*), a song of praise and adoration in honour of a deity, and by the Hebrews, as well as the Greeks, accompanied on some musical instrument. The hymn was a song of joy, not of lamentation. The term is now used in quite an altered sense, and is applied to any short religious poem sung in places of public worship, not being a version of a psalm or taken directly from any of the canonical books of Scripture.

The hymns, or divine odes, of the ancient Greeks generally consisted of three couplets—the *strophe*, the *antistrophe*, and the *epode*. But Menander, the rhetorician, enumerates no less than eight different species of hymns. The hymn appears to be among the most ancient of all poetical compositions, and was originally thought to be dictated by the gods themselves, or at least by men truly inspired. Among the ancients, however, this style of poetico-musical composition was not confined to religious

ceremonies, but was often used as a song of supplication previous to an engagement, and was called the "Hymn of Battle." Thus Xenophon, in his account of the first battle fought by the Greeks against the Persian monarch Artaxerxes, tells us that the two armies were not more than 400 or 500 paces apart when the Greeks, to the great surprise of Cyrus, began to sing the "Hymn of Battle," according to the custom of their countrymen.

The use of the hymn in the Christian Church, however, far surpasses anything even of classic times. It would be unfair to insist too literally on the word hymn, which both Matthew and Mark are made to use in our Authorized Version, since the holy song sung by Christ and his disciples as a fitting close to that ever-memorable Last Supper was probably a Hebrew psalm. Still the fact of a religious song naturally rising to Christian lips in moments of spiritual elevation is thus seen to date from the very act by which the Christian community was formally begun; and we may be quite sure that the song, whatever it was, was one of praise and joy, and not of lamentation or revenge. If it were a psalm it was one of hymn-like character. The infant church soon began to write hymns of its own. St. Hilary began, if even he were not forestalled in the holy work. St. Ambrose and St. Prudentius followed. To the latter many of the famous hymns in the Roman Catholic breviary are traditionally attributed, *Corde Natus*, for example; and to St. Ambrose we are said to owe the magnificent *Te Deum* which still moves millions of Christian hearts. St. Gregory the Great was a great hymn writer: *Nocte Surgentes* is from his pen. Later on the Latin hymn became much extended, and was called a *Prose* or *Sequence*.* These extended hymns of the mediæval church are, although in barbarous monkish Latin, of high rank for mere beauty and poetry, while their unfeigned devotional fervour receives even an additional charm from their reverend antiquity. Of such *proses* the most famous are the Easter Day hymn *Victimæ paschali laudes*, the Whitsunday hymn *Veni Creator Spiritus*, the hymn of the service for the dead, the *Dies Iræ*, and the hymn of the holy communion, *Lauda Sion*. The first three of these, as "Since Christ our Passover is slain," "Come, Holy Ghost, Creator, come," and "Day of Wrath, O dreadful Day," are used with but slight alterations in the Church of England of to-day. The *Dies Iræ* forms the basis of the magnificent requiem music of the Roman Catholic Church, from the awe-inspiring requiem of Mozart to the tremendous production of Berlioz. *Lauda Sion* is familiar to all in its superb musical robe, so exquisitely suited to the inner sense of the words, by Mendelssohn; while the *Stabat Mater* is almost looked upon by many who know no better as a personal appanage of Rossini, though his dramatic rendering of it is inferior in religious effect to the fine classic work of Astorga, or the inspiring thoughts with which Dvořák has reclothed it for the musical religionists of our own day. For the more ancient music of the hymns of the Roman Catholic Church the collection of Palestrina ("Hymni totius Anni," Rome, 1589) is at once the most revered and the most perfect authority. For the poems, an excellent collection is that of Mone. "Hymni Latini Medii Ævi" (three vols. Freiburg, 1856).

At the Reformation Luther, an ardent music-lover himself, most fortunately determined to interest the congregations which followed his views, and to teach them at the same time, by giving them short tuneful hymns to sing during service; and the famous Wittemberg collection of 1524 struck out an altogether new line of usefulness for the hymn. This developed into the chorale, which Bach two centuries later was to raise into a noble art-form as regards its musical side. The Huguenots took up the new style in France under Marot and Beza, with Goudimel's music; and through them Calvin, and through him the English and Scotch Puritans, became devout lovers of hymnody and unceasing singers of hymns. In 1563 the first book of "Hymn Tunes," in four parts, was issued in London by Daye, the composers being Tallis, Edwards, &c.; and Este's well-known "Psalter" followed in 1594, to be superseded in its turn by the famous "Tunebook" of Ravenscroft (1621), with tunes by Tallis, Dowland, Morley, Bennett, and the other glories of the Elizabethan time. Unhappily this splendid era was of all too short duration; and when, under Humphrey, Purcell, and their fellows, English music revived again, it was to the anthem rather than the hymn that their attention was turned. After their time the hymn, in both words and music, sank very low. All can remember, or can easily find, numberless hymns in their words so poor and tasteless and in their tunes so frivolous as now to excite a smile, and which yet were favourites in the last generation. The good examples of Wesley and others gradually bore a tardy fruit, and our collections of sacred song for church use now frequently contain noble and beautiful poems for the most part, while the skipping dance tunes (the Easter hymn "Lo He Comes" was long sung—and perhaps still is sung—to a tune called Hemsley, which was nothing else than "Miss Cattley's Hornpipe") and the dull meaningless drones which formerly formed the only alternatives to them, are banished from our choirs in favour of expressive and characteristic melodies and harmonies. At present the poets are still beyond the musicians in their earnestness as hymn-writers. A certain levity and straining after effect still far too often takes the place of the fitting gravity and dignity which religious music should always retain.

HY'ODON is a genus of fishes belonging to the order PHYSOSTOMI, forming the family Hyodontidæ. Only one species is known, the Moon-eye (*Hyodon tergiscus*), from the great lakes and other fresh waters of North America. The body is from 12 to 18 inches long, covered with cycloid scales, except on the head, which is naked. Barbels are absent. There is no adipose fin, and the dorsal is placed far back. The stomach is horseshoe-shaped. The air-bladder is simple.

HYOSCY'AMINE is an alkaloid obtained from henbane (*Hyoscyamus niger*), natural order Atropaceæ. It is usually extracted from the seed by hot alcohol. When pure it crystallizes in silky needles. It is soluble in water, alcohol, and ether, and forms crystalline salts with some of the acids. It is a narcotic poison, and dilates the pupil of the eye. It is much used in medicine as a narcotic and anodyne, for relieving pain, producing sleep, and allaying irritability. It has the advantage of not constipating the bowels like opium.

HYOSCY'AMUS. See HENBANE.

HYPA'TIA, the daughter of Theon the Younger, celebrated for her wisdom, beauty, and tragic fate, was born at Alexandria probably about the year 370 A.D. Displaying uncommon intelligence during her childhood she was carefully instructed by her father in mathematics and astronomy, and after studying philosophy at Athens she became the head of the Neo-Platonic school of Alexandria. Pure and beautiful, possessed of high intellectual endowments, enthusiastic and eloquent, she soon attracted to her lectures a numerous auditory, and exercised a powerful influence over the minds of her disciples. One of the latter, Synesios, afterwards became bishop of Ptolemais, and some of his letters to her are still extant. The citizens of Alexandria held her in high honour, and it is said she was consulted by the magistrates in important cases. After the accession of Cyril to the patriarchate of Alexandria she became identified with the interests of the prefect Orestes, with whom Cyril came frequently into collision. In consequence slanders, which made her appear detestable as a woman, and the belief that she was the chief moving spirit in the reviving paganism of the city,

were quickly accepted by the supporters of the patriarch, and she became the object of their fanatical hatred. At the commencement of 415 she was seized in the street by a furious mob of Christians, led by one Peter, a reader, and a number of the Nitrian monks, dragged to the Cæsareum, then a Christian church, and there murdered with circumstances of the most revolting barbarity. To what extent Cyril was implicated in the atrocious act of his supporters cannot be accurately determined, but there seems no reason to doubt the assertion of Theodoret that he was guilty of complicity in the matter. According to Suidas, Hypatia wrote two works on mathematics and one on astronomy, but they seem to have been lost at an early period, and of her philosophical teaching nothing is certainly known. The traditions as to her marriage with Isidorus the philosopher, and of her conversion to Christianity, are without foundation, and the Latin letter to Cyril on behalf of Nestorius, attributed to her, is an undoubted forgery.

The name of Hypatia has been made familiar to English readers in one of the best of Charles Kingsley's historical romances.

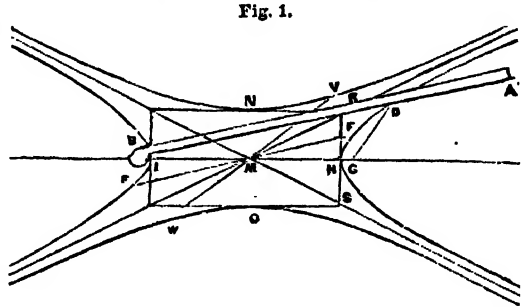
HYPER and **HYPO** are two Greek prepositions much used in the composition of our words. Though they are unfortunately so much alike, their meaning is absolutely opposite; the first means "above" or "over," while the second means "beneath" or "under." Thus the Hyperboreans were the fabled race living *beyond* the north wind (*Boreas*); while the hypoglossal nerve is the nerve *beneath* the tongue (*glossa*). In musical antiquarianism the similarity of sound is perplexing; for in Greek music the *hypos* are our dominants, the *hypers* are our subdominants. Thus the Dorian mode being our scale of D minor (with a C natural), the hypo-Dorian was our A minor (with G natural), and the hyper-Dorian our G minor (with an F natural). The Greek dominant was a Fourth below and ours is a Fifth above, but that is merely a difference of reckoning, the result is the same.

In the mediæval system of the Ecclesiastical Modes [see MODES, ECCLESIASTICAL], these terms, like so many other terms of the Greek music, were misunderstood and perverted; and here *hyper* is equivalent to authentic and *hypo* to plagal, the plagal scale being a Fourth below the authentic in each tone or mode.

HYPER'BOLA. The hyperbola is one of the curves known by the name of CONIC SECTIONS. It is in the application of mathematics the least useful of the three chief curves of this family, the ellipse, the parabola, and the hyperbola; indeed so very rarely does the necessity of using it occur, that it may be a question whether the study of it should form a part of a course of practical mathematics. But there are, in pure analysis, so many analogies which are illustrated by distinctions existing between the properties of the ellipse and hyperbola, that the student who aspires to more than elementary knowledge cannot dispense with the comparison of the two curves. The hyperbola is a curve which is the *locus* of a point moving so that its distance from a given fixed point bears a constant ratio to its distance from a given fixed straight line; but this ratio must be greater than unity—that is to say, the distance from the fixed point must be always greater than that from the fixed straight line, and greater in a given proportion, such as 2 to 1, 5 to 4, &c. A hyperbola may easily be constructed experimentally in this manner; and since there are two cases equally satisfying any position of the moving point on the curve, that namely in which the curve lies between the fixed point and the fixed line, and that in which it has them both on the same side (the outside) of it, it is evident that for every hyperbolic equation there are two curves or opposite hyperbolas. The equation to the hyperbola, when p is the distance between the fixed point and the fixed straight line, is $y^2 + (x-p)^2 = e^2x^2$, where e is the given ratio greater than unity. Or if the origin is transferred to the vertex, and the distance from the vertex is called a, then the equation is $y^2 = (e^2-1)(2ax + x^2)$; or with the origin at the centre, then $y^2 = \frac{b^2}{a^2}(x^2 - a^2)$, where $b^2 = (e^2-1)a^2$. Or if M H in fig. 1 be called a, and M N b, then the equation to the hyperbola is $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$.

But there is a very easy practical way of striking a hyperbola, which may here be given. Referring to the accompanying woodcut (fig. 1) we shall suppose the points

Fig. 1.



B and C to be determined, and a straight ruler, A B, to be made movable on one of its extremities, about the point B, as a centre. To the end, A, of this ruler one end of a thread is attached, the other being fixed at the determined point C. Now, let a pencil be applied to the thread, so as to press a portion of it against the edge of the ruler, as A D, and keep the other portion, D C, tightly stretched. The ruler being made to traverse on the given point B, at the same time that the pencil D moves along its edge—always preserving the tension of the threads—the motion of the pencil or point D will be in the curve D F H, which is that of a hyperbola.

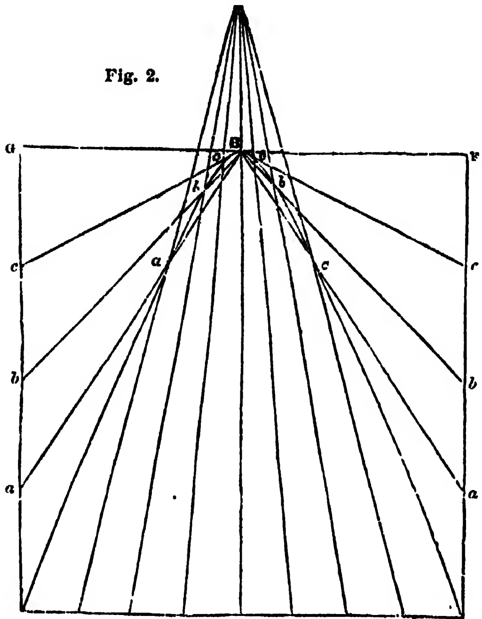
If the extremity of the ruler, which now moves on the point B as a centre, were removed to C, and there made to traverse in a similar manner, the end of the thread now set at C being placed at B, the curve described would be the opposite hyperbola. The points B and C are called the *foci*, and are the fixed points given in the mathematical construction.

A line terminated by the curves of the hyperbola and its opposite, and which, if continued at either extreme, would pass through either of the foci, as I H in the figure, is called the *transverse axis*, and I and H are the *vertices*. A line passing through the *centre*, M, of the figure, at right angles to the transverse axis, is called the *conjugate axis*. Any line, as V W, drawn through the centre, M, is called a *diameter*. If a tangent with either of the curves be drawn to the extremity of V W, another line, as F F, drawn parallel to that tangent and through the centre, M, is called a *conjugate diameter* to that at the extremity of which the tangent was drawn. A line drawn through any diameter parallel to its conjugate diameter and terminated by the curve, is called a *double ordinate*. If any diameter be continued within the curve, and is terminated by the curve and a double ordinate, the part within is termed an *abscissa*. A line drawn through the focus of the figure, and at right angles to the transverse axis, is called the *parameter*.

If a circle be described, with M as a centre and C M as the length of radius, it will cut the conjugate axis in the points N O. (The conjugate axis is not shown in the figure, to avoid confusion of lines; it passes through N M O.) And if through the vertex H a tangent to the curve, as R S, is drawn, parallel and equal to N O, having H R and H S respectively equal to M N and M O, the right lines drawn through

the centre M and the points R and S, as are the lines M X and M Y, are called *asymptotes*. Asymptotes are peculiar to the hyperbola. N and O will be the vertices and N O will be the transverse axis of another pair of hyperbolas, I H now being the conjugate axis, and the asymptotes being

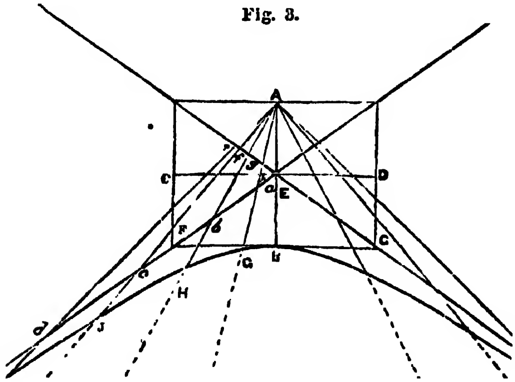
Fig. 2.



common to both pairs. These curves, as W O, N V, are called conjugate hyperbolas to the first pair. If the axes between the vertices are equal, so that I H = N O (not as in the figure, where I H > N O), then the hyperbola is termed equilateral or right-angled, since the asymptotes will cross at right angles. The equation to the hyperbola, when referred to the asymptotes, is $xy = ab$.

The diameter of a hyperbola, A B (fig. 2), its abscissa, B C, and double ordinate, D E, being given, the curve may

Fig. 3.



be readily delineated by determining a certain number of points in its course as follows:—

Through B draw G F parallel to D E, and from the extremities D and E of the ordinates, draw D G and E F parallel to the abscissa B C, cutting G F in the points F and G. Divide C D and C E, each into any number of equal parts, as four; and through the points of division, *a b c*, on each side of the point C, draw lines to A. Divide D G and E F into the same number of equal parts, and from the points of division, on D G and E F, draw lines to B. A curve drawn through the intersections at *a b c*, on each side the diameter, will be that of the hyperbola required.

Or the transverse and conjugate diameters, A B and C D (fig. 3), being given, it is easy to determine a certain number of points in the curve, with a view to its delineation. Through the extremity, B, of the diameter, A B, draw F G parallel to C D, the other diameter; and make B F and B G equal to the semi-diameters E C and E D. Through the points F and G thus determined, draw E F and E G, which will be, when produced, the asymptotes of the figure. From A, as before, draw lines at pleasure towards the curve to be described, as A G, A H, A J, A K, cutting the asymptotes at the points *a b c d* and *e f g h*, &c. Set off the distances A *h*, A *g*, A *f*, A *e* respectively from the points *a b c* and *d* on the lines from A, and the points G H J K will be in the curve required.

HYPER'BOLE (Greek) means literally an overcasting; in its common sense it is a going beyond the truth in describing an object, not by the introduction of qualities which do not belong to it, but by the exaggeration of those which do. For example, it may be hyperbolical to say that the complexion of a fair woman is whiter than snow; but to say so of a brown woman is either irony or simple falsehood. The figure is often employed by orators with great effect, and Demosthenes frequently resorted to it.

HYPERBOR'EANS, a fabled race which lived beyond the north wind (*hyper boreas*), as their name implies, and consequently out of reach of cold and ice. Their land was a land of perpetual sunshine and calm, and the people lived peacefully on the kindly fruits of the earth, free from disease and strife, knowing neither pain nor sorrow. The "blameless Hyperboreans" worshipped the god of light, Apollo, who had once visited their land. They lived 1000 years, unless they tired of life before that time, in which case they leaped from a rock into the sea, after due ceremonies of purification. Later poets give the Hyperboreans a six-months day and night, so that they sowed in the morning, reaped at noon, gathered their fruits in the evening, and stored them at night. Herakles in his pursuit of the Arcadian stag penetrated to the Hyperborean region, but even in fable it was rarely visited.

HYPERICIN'EÆ, an order of plants, belonging to the cohort Guttiferales among the POLYPETALÆ. The species inhabit various parts of the world, both within and without the tropics; they are especially common in the southern parts of the United States. Many are objects of ornament, but they are little cultivated, because they have frequently a disagreeable hircine odour. They are generally astringent, and in some cases, as in the genus Vismia, yield a substance so much resembling gamboge as to have acquired in commerce the name of American gamboge.

In Java a species of Cratoxylon is used as an astringent and diuretic. A stomachic tincture is prepared in the United States from *Hypericum virginicum*. This order is characterized by the following particulars:—There are five (rarely four) imbricate sepals; the petals are of the same number, hypogynous, unequal sided, and bordered with black dots; the stamens are numerous, hypogynous, generally polyadelphous. The ovary is composed of three to five carpels; it is one-celled, or the placentas are sometimes intruded so far as to meet in the centre, and make it more or less three to five celled; the styles are as many as the carpels, and usually distinct and long. The fruit is a dry capsule with many valves, or it is fleshy and indehiscent. The species are herbs, shrubs, or more rarely trees, with opposite or verticillate leaves, which are undivided, commonly herbaceous or small, and usually dotted with pellucid glands; there are no stipules. The hermaphrodite

flowers are generally in trichotomous cymes or panicles, of a yellow (sometimes white) colour. There are 210 species in the eight genera, natives of temperate and warmer regions of the globe.

HYPER'ICUM, a genus of plants belonging to the order HYPERICINEÆ. St. John's Wort is the common name for all the species. *Hypericum perforatum* is found in Britain and throughout Europe; also in the north of Asia and Africa. The flowers are of a bright yellow colour, dotted and streaked with purple. When rubbed they emit a powerful lemon-like scent, and stain the fingers with dark purple. Most of the species of Hypericum are showy, and deserve cultivation. *Hypericum Androsæmum* is grown in shrubberies and on rockeries. The leaves were at one time used for application to wounds, hence the French name "Toute saine," corrupted in English to Tutsan. *Hypericum calycinum* is also frequently cultivated in shrubberies; it affords good cover for game.

HYPERI'ON, the Sun-god of the Titans in the ancient Greek mythology. He was son of Ouranos and Gaia, and became by Theia the father of Helios, the sun-god of the later dynasty of Olympus. Hyperion is the subject of a fine poem by Keats, unhappily only a fragment. The quantity of the syllables is very commonly altered by English poets. Thus Keats uses the pronunciation *Hype'rion*, and in this he follows Shakspeare's "Hype'rion to a satyr" ("Hamlet"). Longfellow, in his prose romance, also prefers the incorrect rendering.

HY'PERMETRO'PIA. See EYE.

HY'PERSTHENE (Gr. *huper*, exceeding; *sthenos*, strength) is a rock-forming mineral closely allied to ENSTATITE and BRONZITE. It is a silicate of magnesia and iron (MgO,FeO,SiO_2), and crystallizes in the rhombic system. Most usually it occurs foliated and massive, with rather a pearly or a metallic lustre on the cleavage faces. Its hardness is 5 or 6, and its specific gravity 3·3. It occurs in many eruptive and metamorphic rocks, and is an essential constituent with labradorite of *hypersthenite* or *hyperite*, a variety of GABBRO. It is not to be confounded with the foliated varieties of HORNBLENDE.

HYPER'TROPHY (Gr. *huper*, above; and *trophē*, nutrition), a term in medicine signifying the enlargement of a part of the body from excessive nutrition. The hypertrophied organ contains no new solid or fluid substance, but one or more of its proper component tissues is in greater quantity than in the healthy state. The opposite condition of a part, namely, diminished bulk from defective nutrition, is termed ATROPHY.

When hypertrophy attains such a degree as to interfere with the action of the organ in which it is seated, it constitutes an important and highly dangerous disease. Such is frequently hypertrophy of the heart.

The treatment consists in the removal of the exciting cause, if this can be effected. The part should be kept at rest as much as possible, all irritation prevented, and the supply of blood diminished.

HYPHÆ'NE. See DOOM.

HYP'NOTISM (Gr. *hupnos*, sleep) is the name given to a peculiar mental condition which greatly resembles somnambulism, but which can be induced in many persons by very simple means. It corresponds to the so-called magnetic sleep of the mesmerists, and it is sometimes termed *Braidism*, from the name of Mr. James Braid of Manchester, who was one of the first to observe and describe the phenomena in a scientific manner.

The method recommended by Mr. Braid to induce this condition is to hold a bright object at from 8 to 15 inches above the eyes, at such a distance as is necessary to produce the greatest possible strain upon the eyes and eyelids and enable the patient to maintain a steady fixed stare upon the subject. The patient must be directed to rivet his attention upon the object, as well as to keep his eyes fixed, and in favourable cases the hypnotic state may be induced in as short a time as ten or fifteen seconds. In this condition, if the limbs are gently moved, the subject displays a tendency to retain them in the position in which they are placed, and as the intensity of the nervous impression increases a state of torpor far greater than that of natural sleep will result. Many of the operations of surgery have been performed upon patients in this state with absence of all pain, and a lesser degree of hypnotism has been employed with great success in the treatment of many forms of disease. In the latter instances the attention of the patient has been strongly directed to the morbid part, and the intense nerve power thus engendered has produced results of the most marvellous character. The attention of several medical scientists has been directed to this subject since the termination of the labours of Mr. Braid, and the results obtained by their experiments appear to indicate that hypnotism possesses important therapeutic uses, and that it deserves a more extensive and thorough investigation than it has hitherto received.

HYP'NUM is a genus of MOSSES in which the fruit or capsule is lateral, unequal, and nodding-sided, the peristome is double, consisting of an outer row of sixteen equidistant, lanceolate teeth, and an inner membrane divided halfway into sixteen teeth alternating with the outer teeth, and with one, two, or three intermediate cilia. The leaves of *Hypnum tamariscinum* are very beautiful, and are much used by makers of artificial flowers in the manufacture of moss-roses. Other species are also ornamental; a very large number are natives of the British Isles.

HY'POBLAST, one of the three layers into which the blastoderm ultimately divides almost immediately upon its formation in the ovum of vertebrates. From the hypoblast or inner layer (next the yolk) is developed the epithelium of the entire digestive tract and that of all the glands opening into it, as well as those of the liver and pancreas, which, though they do not open into it directly, are yet connected with it. From it also comes the epithelial lining of the entire respiratory tract. Just as the epiblast becomes the outer skin, so the hypoblast becomes the internal skin or lining, while from the middle layer, the mesoblast, all the tissues, organs, and nerves arise.

HYPOBRO'MOUS ACID ($BrHO$) is a powerful bleaching agent formed by the action of bromine on the alkalies and alkaline earths.

HYPOCHLO'ROUS ACID, a powerful bleaching agent, the active ingredient in bleaching powder. See CHLORINE.

HYPOCHON'DRIAC and **HYPOGAS'TRIC,** two of the nine regions of the abdomen, respectively named as being beneath (*hupo*) the cartilaginous end of the breastbone (*chondros*) and the entire belly (*gaster*). The middle of the upper region just over the stomach is called epigastric, and the sides are the right and left hypochondriacs respectively. The hypogastric is sometimes called the pubic region; it lies beneath the umbilical region and between the right and left iliacs. As the spleen lay close beneath the chest in the left hypochondriac, and as melancholy mental disorder was attributed to the spleen (the French denominate slight melancholic attacks *le spleen* to this day), persons so afflicted came to be called hypochondriacal.

HY'POCHONDRI'ASIS (Gr. *hupo*, under; and *chondros*, breastbone), a disease which, as stated in the previous article, was formerly referred to derangements of one or more of the abdominal viscera, but which is now known to be a nervous disorder. It is characterized by a morbid anxiety, either without any or having altogether inadequate foundation, as to the state of the bodily health. Persons suffering from this affection are apt to pay the most minute attention to what passes within themselves, and to observe narrowly all the details of the animal and organic life, finding

in everything they observe food for gloomy anticipations of impending trouble. Sometimes the patient suffers from a fixed idea as to the nature of his affection, and believes that his brain, his heart, or his liver is the subject of an incurable and ultimately fatal disease. In other cases there is a rapid shifting of the seat of the imaginary disease, which changes its character as quickly as its location.

The sufferings of hypochondriacs have been termed imaginary, but such a term is not correct if it is taken to imply that they are not serious. Though entirely baseless, and merely arising from an unduly excited imagination, the feelings of depression may cast a gloom over everything, deprive life of all its brightness and hope, and induce a mental condition that can only be described as one of misery. It matters not a pin's point, so far as the mental agony is concerned, whether one is really about to die, or whether one only has the firm conviction that such is the case, and the conviction is completely without reason. A paltry "stitch in the side" may be set down to *angina pectoris* or heart disease, and plunge the patient into terror almost to the pitch of madness; the bodily pain here is trifling, or practically imaginary, but the mental pain is of the most excruciating nature. The pain of the body and the pain of the mind must be sharply distinguished in hypochondriasis. The one may be imaginary, the other is often of appalling reality. The worst actual pain would be welcomed as a relief if its scope were definite, and the sufferer were thus relieved from the crushing dread of the unknown.

Of the causes of this disorder one of the most common is the inheritance of a tendency towards mental disease, and hypochondriasis itself is often transmitted from one generation to another. It is frequently witnessed in young men of studious habits, and is the result of intellectual application unduly severe and prolonged. A far more fertile source is found in luxury and the want of an engrossing occupation; while it occasionally results from other causes, such as misfortune, the excesses to which young men are sometimes addicted, and the prolonged and injudicious use of medicine.

In its milder forms it does not interfere with the performance of the ordinary duties of life, and it is quite compatible with more than the average of intellectual capacity. John Bunyan in his "Grace Abounding unto the Chief of Sinners" depicts a series of hypochondriacal troubles which almost reached the pitch of insanity, and the torments of Dr. Johnson from morbid fears of insanity and death are frequently referred to by his biographers. It has at the present day in all probability a larger influence in the propounding and acceptance of pessimistic views of existence than most philosophers imagine.

Hypochondriasis is very much more common in the male than in the female sex; it is seldom seen in very young people, and rarely makes its first appearance after the age of fifty. Where its symptoms appear early and in a marked degree, and there is at the same time a hereditary tendency to insanity, the affection is apt to pass into melancholia, or the patient may become the prey of certain fixed delusions. When it is induced by other causes, such as excess, worry, idleness, &c., the complaint is more amenable to treatment, and may often be removed. Where any actual disorder is present the proper medical means must be adopted for its removal; but in all cases moral influences must also be sought, and change of scene, travel, and the pursuit of some regular, definite, and useful occupation are among the best means for withdrawing the subjects of this disorder from the morbid and hurtful contemplation of themselves.

HYPODER'MIC INJECTION is the name given in medicine to a method introduced by Dr. Alexander Wood of Edinburgh, and afterwards improved by Mr. Charles Hunter of London and others, of introducing remedial agents into the system by means of a puncture through the skin. The discovery of alkaloids has enabled an effective dose to be administered in a very small compass, and it has been found that when drugs are introduced into the circulation they act much more powerfully than when they are swallowed. The instrument used in this method of administration consists of a hollow needle attached to a graduated glass syringe, and the drug in solution is gently pressed through the needle, which is inserted in a pinched-up fold of the skin. The chief drug administered by this method is morphia, which when used in this way is the most powerful remedy known for the relief of severe and prolonged suffering. Atrophia as a sedative, or for the relief of the profuse night sweatings of consumption, and ergotine, to check internal hæmorrhage, are also introduced into the system by means of hypodermic injections; but experiments made with quinine, chloral, mercury, and other drugs have not been attended with any great success, the local injury caused by the method being such as to outweigh the advantages gained.

HYPOGÆ'IC ACID is a fatty acid obtained from the oil of earth-nut (*Arachis hypogæa*), natural order Leguminosæ. It is a crystalline, inodorous acid, melting at 35° C. (95° Fahr.), soluble in alcohol and ether. It is monobasic, having the formula $C_{16}H_{30}O_2$. It forms a number of soapy salts called hypogæates; also an ether, hypogæate of ethyl ($C_{16}H_{29}(C_2H_5)O_2$), a yellow oily liquid.

HYPOGAL'LIC ACID, an acid obtained from hemipinic acid by the action of hydriodic acid. The formula is $C_7H_6O_4$, and is intermediate between those of salicylic acid ($C_7H_6O_3$) and gallic acid ($C_7H_6O_5$). It crystallizes in prisms, and is soluble in hot water, alcohol, and ether. It has strongly acid properties.

HYP'OGENE ACTION is a term used in geology to include the several forces which, working beneath the surface of the earth, produce internal and superficial changes in the crust. Such agencies are mostly the result of internal heat or chemical action.

The phenomena usually ascribed to hypogene action are VOLCANOES, EARTHQUAKES, and the movements of the earth's crust, producing secular upheaval and depression, with changes in the structure and mineral composition (metamorphism) of the rocks. The term is used mostly in contradistinction to *epigene* or surface action, which is chiefly the result of the circulation of air and water.

Hypogene rocks are those which, it is assumed, have obtained their present composition, structure, and general aspect some distance beneath the surface of the earth.

HYPOGLOS'SAL NERVE, or ninth pair of cerebral nerves (or twelfth pair if the two branches of the seventh and the three of the eighth are separately counted), is called from its special function the *motor linguæ* or tongue-mover. It also contributes to the supply of the submaxillary gland. It is exclusively a motor nerve.

HYPONI'TROUS ACID. See NITROGEN.

HYPOS'TASIS (Gr., subsistence or real being), a term which was brought into prominence during the Arian controversy, and which has retained its place in theology ever since. Originally it meant only a real personal existence; hence when Arius said there are three *hypostases* he meant three natures or substances. At a synod held by ATHANASIUS in 357, it was distinguished from the term *ousia*, substance, and explained as being synonymous with *prosopōn*, which in Latin was rendered *persona*, and it has ever since been used in this sense by Catholic theologians.

HYPOSTATIC UNION is the term used in orthodox theology to designate the union of the divine and human natures in Christ, concerning which the chief points maintained are that the God-man is one person, that the two natures are inseparably united, and that each nature is complete in itself, even after union, so that none of the attributes of either is transferred to the other.

HYPOSUL'PHUROUS ACID. See SULPHUR.

HYPOT'ENUSE (Gr. *hupoteinousa*, subtending) is a term which has always been applied since the time of Euclid to the side of a right-angled triangle which subtends, or is opposite to, the right angle. It is sometimes quite incorrectly spelt *hypothenuse*.

HY'POTHEC is a term derived from the Roman law, still in use in the law of Scotland, and in that of France under the name of *hypothèque*, but is not a received technical expression in England. It represents certain legal rights of HYPOTHECATION possessed by certain persons. Thus a landlord in Scotland used to have a hypothec over the crops and furniture of his tenant for his rent; a law agent or attorney still has a hypothec over the title-deeds of his client, for his account or bill of costs; and seamen over a vessel in respect of their wages. The second illustration we have given is always called a hypothec in Scotland, but it is clearly a lien. A royal commission was appointed to investigate the law of hypothec in Scotland, as applied to agriculture, in 1864, and an Act was passed in 1867 removing many practical objections. The opponents of the law were not, however, satisfied, and in 1869 a select committee of the House of Lords was appointed to inquire into the matter. In their report they stated that the main difference between the law of hypothec in Scotland and the law of distress in England was, that in Scotland the landlord had the power of preventing the tenant from disposing of his crop before the rent became due. They were against any extensive alteration in the law, and stated that some of the objections urged against it were good also as against the law of distress in England and in Ireland.

By the 43 Vict. c. 12, passed in 1880, it was enacted that after the 11th November, 1881, the landlord's right of hypothec for the rent of land exceeding 2 acres should cease; but that he should have the same rights and remedies against his tenant when six months' rent was due as had been previously provided for by the law of Scotland when twelve months' rent was due; and the same remedies when twelve months' rent was due as had previously been provided for when two years' rent was due. The Act contains provisions that a tenant removed or ejected shall not thereby forfeit the rights of an outgoing tenant, to which he would have been entitled if his lease had naturally expired at the date of removal or ejection; and if the ejection takes place between Whitsunday and Martinmas, he shall be entitled to payment of or credit for expenditure made since the last preceding term on labour, seed, and manure, on any crop other than an away-going crop. Nothing in the Act is to apply to any claim for rent due, or which might afterwards become due, under any lease, writing, or bargain current at the date of its becoming law. The Act does not apply to urban property.

HYPOTHECA'TION (Gr. *hupothēkē*, a pledge or mortgage) is the giving over anything as a pledge, as when property is hypothecated by a debtor as security for his debt. But since the security still remains in the hands of the debtor (as in the cases of a mortgage, of a bill of sale, &c.), hypothecation is clearly distinguished from pawning, i which the property is transferred to the creditor. Immovable property and expectations, though they cannot be pawned, can thus be hypothecated; and foreign governments often hypothecate certain state domains, revenues, duties, or taxes, when hard pressed for money.

HYPOTH'ESIS (Gr. *hupothesis*, supposition), literally, the act of placing one thing under another, that the latter may stand upon and be supported by the former; metaphorically, the assignment of any cause or reason why an observed event or phenomenon should have happened, or must result from a certain pre-existing condition of things. Assumed causes or hypotheses often have to be employed to explain natural phenomena and ascertain real causes. Thus, when Newton became convinced of the existence of a principle of gravitation, though he had no positive proof of it, he assumed such to be the case, and in working on that hypothesis at last proved its correctness and established it as a fact. Great differences of opinion exist as to what constitutes a legitimate scientific hypothesis. Mill, Comte, and others consider that a sound hypothesis can only be established when the cause assigned to any phenomena is a real cause, or capable of being ascertained to be a real cause by experiment and calculation, as in the case of the law of gravitation. Dr. Whewell and others, on the contrary, are of opinion that in such a case as the undulatory theory of light—which not only explains many complicated phenomena relating to that subject, but has actually led to the discovery of new facts by the inference of the truth of the hypothesis, although, as yet, the ethereal substances whose undulations are supposed to constitute light in its passage from the sun to the earth are not known to have a real existence—a sound hypothesis has been established, at least until such time as some discordant facts arise, when it must, of course, be modified or abandoned.

HYPSOM'ETER or **THERMOBAROMETER,** a small metallic vessel for boiling water, fitted with a delicate thermometer graduated from 190° to 212° Fahr., so that fine subdivisions of the degrees can be easily read, and used for determining the height of places by means of the boiling-point of water. It is accurate within 10 feet. See HEIGHTS, MEASUREMENT OF.

HYRACOI'DEA is an order of MAMMALIA, established by Huxley for the reception of the single genus HYRAX. Flower admits the hyrax and the elephant within his enlarged order Ungulata, making them the types of the suborders Hyracoidea and Proboscidea. Palæontology does not throw any light on the affinities of this remarkable genus.

HY'RAX is a genus of mammals of small size, resembling a rabbit in external appearance and mode of life. For this reason they were formerly classed with the Rodents. Such an alliance, based only on superficial resemblance, was found to be incorrect when the anatomy of hyrax was studied. Cuvier placed them among his order Pachydermata. Huxley has established a separate order, Hyracoidea, for their reception, in which course he has been followed by most modern zoologists. The dentition consists only of incisors and molars, the dental formula being—

$$I.\ \frac{1-1}{2-2};\ c.\ \frac{0-0}{0-0};\ pm.\ \frac{4-4}{4-4};\ m.\ \frac{3-3}{3-3} = 34.$$

The upper incisors of hyrax are not formed, like those of the Rodentia, in the shape of a quadrangular prism, or in that of a cylinder curved and terminated by a truncation or a corner-edge. They are triangular, and terminate in a point, recalling the canines of the hippopotamus. The lower incisors are laid forward, like those of the hog; they are flat and dentilated in youth, but soon become worn by attrition against the upper incisors. The molars represent those of the rhinoceros, both in number and form, so that, were it not for the size, they might be mistaken for each other. The hyrax has twenty-one ribs on each side, a number superior to that possessed by any other mammal except the sloths; the elephant and tapir have twenty. The fore feet are divided each into four toes tipped with hoof-like nails; the hind feet into three, of which the innermost is furnished with a long claw-like nail. The toes are all buried in the skin as far as the little hoofs, precisely as in the rhinoceros. There are no clavicles. The stomach resembles that of a rhinoceros or horse; besides the ordinary cœcum an additional pair of large conical pointed cœca are found. The female has six mammæ, four inguinal and two pectoral. The skin is thickly clothed with hair, the face being well supplied with stoutish bristles on the muzzle and immediately above the eyes; similar thick hairs

are also here and there interspersed throughout the fur at different parts of the body. The ears are short, and the tail is represented externally by a mere tubercle. These animals are all small, the largest not exceeding 18 inches in length. Herbage and various kinds of grass constitute their food.

Several species of hyrax have been described. Of these the Syrian Hyrax or Daman (*Hyrax syriacus*) is of interest as being the animal called "shaphan" in the Bible, a name which is translated in the English version *cony*. It is found in Syria, Arabia, and Abyssinia. The body is about 12 inches long, possessing a similar measurement in height. The fur exhibits a grayish-brown colour above, being fulvous at the sides and whitish underneath; the individual hairs are annulated by these several shades, their relative amount varying according to the region of the body in which they occur. The damans are gregarious, selecting for their habitations those inaccessible caverns and clefts which the rocks of Syria so abundantly afford. They delight to bask in the sun near their snug retreats, exhibiting great caution and timidity. The conies are, as Solomon aptly expresses it, a "feeble folk," although they have "their dwellings in the rocks."

The Cape Hyrax (*Hyrax capensis*) or Dasse (Dutch-badger) is an inhabitant of the mountainous districts of Southern Africa generally, both inland and along the coast. It is about the size of a rabbit, and conceals itself in the holes and the crevices of rocks. It lives in colonies, and feeds upon grasses, aromatic herbs, and the young twigs of bushy shrubs. It is readily tamed. The flesh is said to be excellent. Several species of hyrax are arboreal in their habits, and are sometimes placed in a separate genus, Dendrohyrax. *Hyrax arboreus*, a South African species, is distinguished by its longer fur, which also displays a white spot on the back. No fossil remains of hyrax have been found.

The Cape Hyrax (*Hyrax capensis*).

HYRCA'NUS, JOHN, one of the Asmonæan rulers of Judæa. He succeeded his father Simon in the high-priesthood, B.C. 135. During the first year of his reign (134) Jerusalem was besieged by Antiochus Sidetes, and after a long siege Hyrcanus was obliged to submit; but he eventually established his independence. The latter part of his reign was troubled by disputes between the Pharisees and Sadducees. Hyrcanus originally belonged to the Pharisees, but quitted their party, and became in consequence very unpopular with the common people. He died B.C. 106, and was succeeded by his son Aristobulus, who was the first of the Asmonæan princes who assumed the royal title.

HYRCA'NUS II. was the eldest son of Alexander Jannæus, king and high-priest of the Jews. At the death of Alexander the regal authority was assumed by his widow, Alexandra, a princess of much wisdom and virtue, and the pontificate was conferred on Hyrcanus. When his mother died (B.C. 69) he was declared king, but was soon after deprived of power by his brother Aristobulus, who was of a daring and ambitious disposition. Hyrcanus, who was a man of easy and peaceful temper, would probably have remained content with the private position to which he had been reduced, but he was persuaded by Antipater to seek the aid of Aretas, king of Arabia Petræa, to whose court he went in the year 65 B.C. In compliance with the entreaties of Hyrcanus, Aretas marched against Jerusalem, defeated Aristobulus, who, with his partisans, took refuge in the temple, and delivered the city into the hands of Hyrcanus. Both Aretas and Hyrcanus, however, were compelled to withdraw from Jerusalem, by order of Emilius Scaurus, Pompey's lieutenant, who had been gained over by bribes and promises to espouse the cause of Aristobulus. Shortly after the matters in dispute were submitted to Pompey by the brothers, who appeared in person before him; but the evident desire of the Roman to show favour to Hyrcanus roused the fiery temper of Aristobulus, and prevented an amicable arrangement. Aristobulus attempted for a while to resist, and the city of Jerusalem was subjected again to the privations of a siege, at the close of which Hyrcanus was restored to the office of high-priest, with the title of prince. He lived several years under the protection of the Romans, but in the year 40 B.C. Syria was invaded by Pacorus, the son of the king of Parthia; and Antigonus, the son of Aristobulus, having through the influence of Pacorus gained possession of the person of Hyrcanus, cut off his ears, in order to incapacitate him for the priesthood, and sent him as a prisoner to Seleucia on the Tigris. Several years afterwards he was induced by Herod to go to Jerusalem, where, under pretence of being concerned in treasonable designs, he was put to death in his eightieth year.

HYS'SOP (*Hyssopus officinalis*) is a species of plant belonging to the order LABIATÆ. A decoction of the

leaves was at one time used as a carminative in flatulence and hysterical complaints. It is a small bushy perennial, about 2 feet high, with leafy spikes of violet flowers. It is a native of Southern Europe and Western Asia, and was introduced into English gardens as early as 1548.

Hedge hyssop is a species of the order SCROPHULARINEÆ, known to botanists as *Gratiola officinalis*. It is a purgative, emetic, and diuretic, and was formerly officinal in the Edinburgh Pharmacopœia, being recommended for dropsy and scrofula. The name *Gratia Dei*, by which it was known to the herbalists of old, shows in what high estimation they held it. In large doses it is poisonous, and in Switzerland it is sometimes so abundant in the meadows as to injure the cattle which graze in them.

The identification of the hyssop of the Bible has been a matter of controversy with botanists; but they agree that it is not *Hyssopus officinalis*, which is not a native of Palestine. Celsius, who wrote in the seventeenth century, examines at great length the claims of eighteen plants; among these are southernwood, wormwood, wall-rue fern, maiden-hair fern, and several labiates, such as thyme, mint, marjoram, germander, lavender, and rosemary. Hasselquist, a pupil of Linnæus, collected plants in Palestine, and suggested that a very minute moss, growing generally not more than one-sixth of an inch high, was the hyssop. This opinion was founded on the reference to Solomon's acquaintance with plants—"He spake of trees, from the cedar-tree that is in Lebanon even unto the hyssop that springeth out of the wall" (1 Kings iv. 33); and it was adopted by Linnæus in his "Flora Palæstina." Other botanists have not followed Linnæus, for this moss is evidently unsuited for the purposes to which hyssop was applied. Sprengel was the first to propose the caper plant, and Dr. Forbes Royle has adopted this view for the following reasons:—The Arabic name for the caper, *asuf*, is somewhat similar to *ezob*, the Hebrew word translated hyssop; it is found in Egypt, the peninsula of Sinai, and round Jerusalem; it grows upon walls; it is considered to possess cleansing properties; it used to be preserved in vinegar; and it is large enough to yield a stick or reed, apparently required by the narrative of the crucifixion. He rejects the labiates as not being considered in the East to possess cleansing properties, and not, with the exception of rosemary, growing so long as to furnish a stick. Tristram, Stanley, and others have adopted this identification. [See CAPERS.] Mr. Carruthers, in the "Bible Educator," comes to a different conclusion. He maintains that the passage in the Psalms (li. 7), "Purge me with hyssop and I shall be clean," does not imply that the plant possessed cleansing properties, but merely refers to the use made of it in ceremonial cleansing for sprinkling the blood. (See Lev. xiv. 4–7, 48–53; Num. xix.) From these passages it will be seen that the hyssop was associated with cedar-wood for the purpose of sprinkling, and that the water of purification must have been in constant use, as every death brought ceremonial uncleanness on at least one person. Thus Mr. Carruthers gets rid of the necessity for considering that the hyssop plant must have furnished a long stick, and still explains the apparent discrepancy of the narratives, in one of which (John) the sponge is said to be put upon hyssop, and in others (Matthew and Mark) upon a reed. "The word used here (**καλαμος**) primarily means the straight culm or stem of a large grass; then any straight rod, as a measuring or fishing rod. It may with great propriety be here understood of the straight cedar-rod to which the bunch of hyssop was tied. And instead of looking for some indigenous plant growing conveniently for use at Calvary, we believe that the place of the crucifixion was beside a station for the water of purification, and in the narrative we see the unpremeditated appropriation of the necessary hyssop-sprinkler conveniently at hand, and specially fitted to convey the vinegar-filled sponge to the lips of the dying Saviour." It is noticeable that the same word is used for the reed placed by the soldiers in Christ's hand as a mock symbol of royalty: "the weak, crooked, trailing stem of the caper would not have been appropriated and would not have been called a cane or reed." Mr. Carruthers concludes:—"The straight, pliable, herbaceous stems (of the labiates) would permit their being easily made into a 'bunch,' while the more or less hairy leaves which clothe the stem would take up as well as freely scatter any fluid. We consequently see no reason for doubting that Origanum, the traditional hyssop, was the plant employed by the Jews. It is, however, probable that several of the plants of this family which are closely allied in form and habit to the Origanum, and are found in similar localities, were also used."

HYSTE'RIA (Gr. *hustera*, the womb), a disease formerly supposed to arise from a disturbed state of the uterus, but which is now known to arise from a disordered condition of the nervous system, without any necessary connection with that organ.

The commonest and mildest form of this affection, usually termed a fit of hysterics, generally occurs after some unusual mental excitement, or after a period of lowness and depression of spirits. Pains are felt in the side or abdomen followed by the sensation of a ball or egg, the *globus hystericus* rising with a twisting vermicular motion towards the throat, where it induces a sense of suffocation. This is followed by a temporary state of loss of sense and voluntary power, or of convulsive struggles followed by outbursts of tears or laughter, after which the patient gradually recovers. After the paroxysm a large quantity of pale limpid urine is commonly voided, the abdomen may be distended with wind, and there is a feeling of faintness and exhaustion, often attended with headache. In more severe cases the struggles during the fit may be of a very violent character, and considerable forcible restraint may be necessary to prevent injury to the patient or to others. Shrieks, sobs, laughs, and cries follow in quick succession, the head is thrown backwards so that the throat projects, the eyelids are closed but tremulous, and the jaws are firmly shut, though there is little or no distortion of countenance. The respiration at such times is slow and laborious, the neck and throat being frequently grasped with the hand, and there is a sense of weight and oppression on the chest. Such a fit may last only a few minutes, or it may be prolonged for two or three hours, and very often there are alternations of spasm and quiet lasting for a much longer period.

During a fit of hysteria care should be taken to prevent the patient from receiving injury during the convulsive struggles, the dress should be loosened, so that the circulation is not impeded in any way, fresh cool air should be freely admitted, and cold water should be dashed upon the face, head, and hands. Where the sudden and lavish effusion of cold water is impossible, the face and hands may be flapped smartly with the end of a wet towel. Smelling-salts may be held under the nostrils, and if the patient can swallow, a dose of bromide of potassium, or of the ammoniated tincture of valerian, may be given with advantage, or a little sal volatile in water may be useful. After an attack has subsided, and to prevent recurrence, attention must be paid to the general health, for the promotion of which regulation of diet, cold bathing, exercise in the open air, the avoidance of all habits which tend to bring about nervous excitement, and the judicious use of such medicines as iron, quinine, nux vomica, and the valerianate of zinc, will be found useful.

In its chronic form hysteria is one of the most difficult and perplexing of all the complaints with which a physician has to deal. Persons under its influence are apt to simulate a variety of diseases, and they often do this so skilfully as to deceive even practised medical observers.

Peritonitis, paralysis, painful affections of the breast, spine, hip and knee joints, &c., have often been complained of, and the patient has persisted in the complaint, even when the treatment has involved considerable inconvenience and suffering. Occasionally the deception is wilful, and arises from malingering, or a desire to excite sympathy and attention, but more often the hysterical patient, though prone to exaggerate the symptoms, does really believe herself to be the subject of the disease. A still more serious form of the affection, known as *hystero-epilepsy*, more common on the Continent than in England, has been described by Professor Charcot and others, in which the symptoms are of a most extraordinary and inexplicable character. It is often characterized by pain over one of the ovaries, the convulsive seizures are severe and prolonged, the limbs are often contracted, and one side of the body becomes insensible to pain, an insensibility which may be shifted to the other side of the body by the application to the skin of plates of metal or the ends of a magnet.

Hysteria in its chronic form is very difficult to remove, but it has a tendency to disappear after the climacteric period. Sometimes the general nervous symptoms will resist every mode of treatment; but where mental and moral influences can also be brought into operation to aid the physician in his efforts to give tone to the system, much benefit may result.

HYTHE, a municipal and parliamentary borough of England in the county of Kent, and one of the Cinque Ports, 75 miles from London by the South-eastern Railway, is situated at the foot of a steep hill or cliff about half a mile from the shore, and consists chiefly of one long street parallel to the sea. There is a rather extensive avenue of trees from the principal street to the water side. The marine parade and sea wall form an unbroken drive of 5 miles along the coast to Folkestone, and constitute one of the most extensive, easy, and pleasant promenades that any place in England can boast of. The town-hall and market-place are in the centre of the town. Besides the beautiful church of St. Leonard, there are three dissenting chapels, schools, two hospitals, library and reading rooms, a county hall. and a small prison. The now well-known school of musketry, whose rules are observed by all the volunteers in Great Britain, was established here in 1855; and on the beach, which is higher than the town, are posted several strong martello towers. Between Hythe and Shorncliffe commences the military canal, 90 feet broad, which runs across the Romney marsh for a distance of 23 miles to Rye. It was made in 1805, but it has never been of much use. The corporation of Hythe, under the Municipal Reform Act, consists of four aldermen and twelve councillors. Hythe formerly returned two members to Parliament, but since 1832 it has sent only one. Although Hythe is one of the chief Cinque Ports, in actual locality West Hythe, some 2 miles west, was the original and most important harbour. At West Hythe, or rather Lymne, was the *Portus Lemanis* of the Romans, now quite 2 miles from present high-water mark, showing what great changes have taken place in the conformation of the coast. The harbour of Hythe was silting up in Elizabeth's time, and the town is now a kind of compromise between a watering-place and a military station, in which latter capacity, indeed, it is best known. The parliamentary borough includes the municipal borough, the liberty of the town of Folkestone, and the parishes of West Hythe, Saltwood, Cheriton, and Folkestone, and part of that of Newington. These limits include the watering-place of Sandgate. The population of the municipal borough in 1881 was 4173; of the parliamentary, 28,239.

HYTHE BEDS, in geology, are a series of sands and sandstones, sometimes ferruginous, with beds of limestone and chert, which form one of the subdivisions of the Lower Greensand. [See CRETACEOUS.] The Hythe beds vary in thickness from 80 feet at Sevenoaks, to 300 feet at Hind Head; they rest on the Atherfield clay, and are succeeded by the Sandgate Beds. Some of the local beds have special names, as the *Kentish Rag*, which is an impure fossiliferous limestone, yielding a good building stone; and the *Hassock* or *Calkstone*, which is the name applied to some of the sandy beds.

I is a vowel which represents two different sounds in English. The letter had not always its present simple form. In Hebrew it is called *jod* (a hand); and from the kindred Phœnician our alphabet springs. Some philologers have considered that the crooked lines for I to be found in some of the columns in the woodcuts illustrating the article ALPHABET were intended to represent the hand, and that afterwards the index finger was considered sufficient, reduced in representation to the form of a simple stroke.

Pronunciation.—(1) The letter *i* denotes a rapid pronunciation of the diphthong *ai*, as in *pine*, *dine*; but anciently it had the true continental pronunciation, for which in English we now use the double *e*. The sound that a Frenchman would express by *file* we now write *feel*, but we ourselves would formerly have written it *file*. This change from the *ee* to the *ai* sound of long *i* came about as late as the fourteenth and fifteenth centuries. In the series of the vowels established by the experiments of Willis, *i*, as denoting the *ee* sound, lies at one of the two extremes. It is pronounced with the lips retracted so as to shorten the vocal tube, whereas the same organs are protruded to produce the sound represented at the other extremity by *u*. In producing this latter sound, which we may call the continental long *i*, the vocal cavity takes the form of a bottle with a wide neck, the neck being represented by the tongue, which is raised towards the roof of the mouth. (2) It denotes the short open *i* sound, as in *pin*, *din*. The Greeks and Romans had also two sounds for *i*, the long sound (probably our *ee*) and the short sound (probably our short *i*); and the Romans in early times indicated the long sound by lengthening the letter above the line of the rest, thus: FILIUS. Here the first *i* is long and the second short. This replaced the older method of doubling the long letter, as FIILIUS.

The letter is interchangeable as follows:—

1. With the diphthongs *ai*, *oi*, *ei*, as in the Latin language, where *alais*, *requairo*, *pueroi*, *puerois*, *nulloius*, *deico*, &c., were corrupted into *alīs*, *requīro*, *puerī*, *puerīs*, *nullīus*, *dīco*. In the same language, when one *i* was followed by another *i* it was not uncommon to denote them by a single long *i*, as *tibīcen*, *Chīus*, *alīus* (gen.), for *tibiicen*, *Chiius*, *aliius*.

2. The short *i* was interchangeable with nearly all the short vowels, more particularly in the penultimate syllables of polysyllabic words, which are very indistinctly pronounced. Thus the Greek *mêchănê* is in Latin *māchĭna*. In the same manner the nomad races of North Africa are called by the Greeks *Nomadês*, by the Romans *Numidæ*.

Bonitas must have been originally *bonotas*, and would have been written in Greek with a termination *-otês*. Lastly, in a large number of words a short *u* degenerated into an *ĭ*: as *maxsŭmus*, *decŭmus*, *recŭpero*, *scribŭmus* (compare *sŭmus*), into *maximus*, *decimus*, *recipero*, *scribimus*.

3. A short *i* before *n* or *m* is not unfrequently in French changed into *ai* or *a*. *Vincere* is in French *vaincre*, &c. In the same language the vowel *i* is changed into *oi* very commonly, as *sitis*, *soif*; *mi*, *moi*; *fides*, *foi*; *Ligeris*, *Loire*, &c., and this though the *i* in Latin be short. The vowel *i* is often inserted after the vowels *a*, *o*, and *u* in French, particularly when a contraction has taken place, as *aimer*, *connaître*, *réduire*, from *amare*, *cognoscere*, *reducere*. See the article on the letter A.

4. When the vowel *i* in the Latin language has a vowel after it, and is preceded by one of the consonants *p*, *b*; *t*, *d*; *c*, *g*, the derived languages have often a sibilant in the place of the former consonant. Thus *sapiam* is in French *sache*; *rabies*, *rage*; *ratio*, *raison*; *medius*, in Italian, *mezzo*. The double sound of *c* and *g* in our own language may have originated in this way.

A similar change occurs in other cases, as *simia*, French *singe*; *vindemia*, *vendange*; *lineus*, *linge*.

I as a numeral in the Roman system of numerals stands for one, and may be repeated as many times as is required to express the desired number of units; as, II = 2, III = 3, &c. The circle among the Romans stood for 1000; half the circle, or the letter D used to represent it, is therefore the sign for 500, but it is more commonly represented by Iↄ. The sign for 1000, CIↄ, is in like manner very commonly represented CIↄ, the C sign before the I sign being level with it, and the reverse ↄ which follows the I being carried below the line. Following this idea further, Iↄↄ = 5000, and CCIↄↄ = 10,000, and so on. But in all these signs I is not the unit, nor in any way derived from it; it is the vertical diameter of the circle.

I is also the first personal pronoun in English in its nominative case. See PRONOUN.

I frequently occurs in mediæval works—for instance, in the original editions of Shakspeare—as a sign of affirmation. It is now printed *Ay* or *Aye*. It is undoubtedly in this case a corruption of *yea*.

I occurs in two abbreviations of widely different meaning, I.O.U. and I.R.B. (Irish Republican Brotherhood), the latter a favourite headline with the disaffected Irish.

In the sacred monogram I.H.S., the vowel stands for the initial of Jesus.

I.O.U. is a punning contraction of the phrase *I owe you*, recognized seriously, however, in business circles. It is simply an acknowledgment of indebtedness, and therefore whatever be its amount it requires no stamp. It is not negotiable, and is of value only to the person to whom it is addressed. It bears no date for payment (if it did, it would no longer be an I.O.U. but a promissory note, and would require stamping); on the other hand it may be sued for at any time.

Its form cannot be too simple, even the date of issue being often omitted, lest it should in long-deferred cases outrun the Statute of Limitations, which limits the power of suing for debts to six years from the cause of action. Usually it runs thus:—

LONDON, *Jan.* 1, 1885.

To Mr. A. Brown,

I.O.U. Fifty pounds.

£50. JOHN SMITH.

If it is desired that the loan shall bear interest, this will not destroy the character of the I.O.U., nor will it render it liable to stamp duty. The form would then run thus:—

LONDON, *Jan.* 1, 1885.

To Mr. A. Brown,

I.O.U. Fifty pounds with interest from this date at 5 per cent. per annum.

£50. JOHN SMITH.

IAC'CHOS or **IAK'CHOS** was the special name of the "noisy god," Bacchus (Bakchos), in the Eleusinian mysteries. A particular hymn of mingled shouting and singing, riotously bellowed forth by the half frantic or wholly frantic worshippers in honour of the god, was called the *Iacchos*, whence the name of the god on these occasions arose. There seems a manifest intention to separate the god from the Bacchus or Dionysus, son of Semele [see DIONYSUS], and in the mysteries Iacchos was certainly taught as the son of Zeus and Demeter. This is only one of very many irreconcilable difficulties arising out of the discrepancies in the numerous forms of worship, attributes, powers, and accounts of parentage and origin of this many-sided divinity.

IAM'BE, daughter of the god Pan and the nymph Echo, was a Thracian woman who served Metanira when the goddess Demeter was searching for her daughter Persephone (Proserpine). The rough and yet kindly pleasantries of Iambe served to turn the thoughts of the sorrowing goddess. It was the custom among the ancient Greeks for some witty fellow dressed as Iambe to meet the worshippers at the bridge over the Cephissus, as they returned to Athens from celebrating the Eleusinian mysteries which Demeter had herself founded in commemoration of her long troubles. The mock Iambe showed his wit by scathing satirical impromptu verses on all who passed by, and an epigrammatic style of verse, witty but coarse, rough, biting, and sarcastic, was called iambic in consequence.

IAM'BICS. The iamb or iambic foot of poetry is a foot of two syllables, a short syllable followed by a long one. If we substitute stress for quantity, as we do in modern poetry, then an iamb consists of an unaccented syllable followed by an accented syllable. *Delay'*, *about'*, are examples of iambs in modern English; *ămō*, *ămās*, *ămănt* will serve for classical examples.

Archilochus (or Archilochos) was the first poet to bring the iamb into prominence. The even ponderous swing of the epic hexameter with its spondees (— —) and dactyls (— ◡ ◡) did not suit his sarcastic verse, and the quick rattle of the springing iamb was far preferable to him. Thus as he wrote the poems called Iambics [see IAMBE] in a combination of iambs and the converse trochees (— ◡) the term which originally applied to the style of the poem soon became fixed also to its material. The far greater brilliancy and flexibility of iambic verse make it also the favourite metre of the Greek tragic poets. In the metre, which is so much their own as to be called the "tragic trimeter acatalectic," the whole six feet (or three metres) may be and not unfrequently are all iambic, but other feet are also permitted for variety and facility of composition. This is a favourite metre with the Latin poets also. Here is an acatalectic trimeter from Horace, consisting entirely of iambic feet:—

Suis | et ip- | sa Ro- | ma vi- | ribus | fuit |

1. 2. 3. 4. 5. 6.

The anapæst (◡ ◡ —) in proper names is admissible in every place except the last, with this restriction, that the anapæst must be contained in one word. The comic trimeter admits the same feet as the tragic, and also a

dactyl in the fifth place, and an anapæst in common words in every place but the last. Much of the beauty of the iambic trimeter depends upon the cæsura, which usually occurs in the middle of the third or the middle of the fourth foot.

In modern English poetry iambic measures may almost be said to be universal, so excessively common are they. A glance at any popular collection of poetry will serve to show this.

The qual- | ity of Mer- | cy is | not strain'd. |

On Lin- | den when | the sun | was low. |

IAM'BLICHOS, a celebrated philosopher of the fourth century (died about 330 A.D.), was a native of Chalcis, in Cœle-Syria, and a pupil of Porphyry. He reached the height of his fame under Constantine the Great, when (and for long after) his fame quite eclipsed that of Porphyry or even Plotinus. The Emperor Julian, who was born about the time Iamblichos died, used to call him "the divine," so highly did he revere his teachings. Iamblichos is usually classed as a Neo-Platonist, but with little justice. He is rather a Pythagorean than a Platonist, holding to queer mystical jugglings with numbers and the like. His Platonism is more in style than essence. He reorganized the polytheistic heaven, welcoming Oriental and Greek gods alike (but of course remaining a firm opponent of Christianity), and ever adding to the number of divinities held up for reverence. Yet like all the Neo-Platonists, Iamblichos held the doctrine of a Supreme Unity; nay, even of two unities, for the Supreme Good which Plotinus considered to lie at the root of all things has a possible contrary (a Manichæan would rather say has an undoubted contrary), and Iamblichos therefore taught that there was One above the Supreme Good, a Supreme Being entirely without attributes or without such as could be expressed, and which therefore had no contrary, but existed alone, incomparable, ineffable, incontrovertible. Under this One comes the Supreme Good, which manifests itself in the world of thought, from which springs the thinking world. The thinking world is divided into three—mind, power, and creativeness (the Demiurge). The next emanation from the Good is the world of soul, curiously divided into three in a manner too mystical for our space to allow its explanation. In the world of soul exist the gods, the angels, the dæmons, and the heroes, with settled numbers according to mystical rules, extending to vast multitudes. Lowest of all comes the world of matter, the sensible or visible world.

A fair amount of Iamblichos' writings yet remains. The most important work is the "Life of Pythagoras," half of which has come down to us. It is written as an introduction to Plato. With the same view the "Introductory Discourses to Philosophy" were also written. "Elements of Mathematics" and "Arithmetic," and a very curious (and occasionally from our point of view rather absurdly superstitious) account of "Egyptian Mysteries" complete the chief works, but there are other fragments.

IAN'THINA is a genus of gasteropodous molluscs, belonging to the family Ianthinidæ and order Prosobranchiata. The species of the genus Ianthina or Violet Snails have a small flat foot, which is furnished with a raft-like appendage on its hinder part, on the underside, which serves an important purpose. The shell is thin, translucent, and spiral, with a very small, sinistral nucleus. It resembles in shape that of a helix, but is of a close vitreous texture. The aperture is large, somewhat quadrangular, with a strongly-twisted columella, and a thin, sharp outer lip, notched at the outer angle. The species all partake, more or less deeply, of a violet hue—hence the name of the genus. The animals appear to be quite blind, having eye pedicles at the base of the tentacles, but no trace of eyes. They are pelagic, that is, they are found floating about on the surface of the ocean, often in myriads, and apparently always gregarious.

The raft or float is an extreme modification of the operculum; it is much too large to be withdrawn into the shell. This curious appendage is composed of numerous cartilaginous air-vesicles. It is entirely secreted by the foot, and it has been found that when a portion is removed the injury is rapidly repaired. In addition to using this appendage as a float, the animal attaches its egg capsules to its under surface, suspending them there by pedicles. It was ascertained by the *Challenger* expedition that when the egg capsules are full, the float is cast off and drifts about on the surface till the eggs are hatched, the Ianthina being still able to float. The animal is often found attached to one of the floating colonies of Hydrozoa, such as the Portuguese Man-of-war. On certain of these Hydrozoa, especially the small blue-coloured Velella, the Ianthina feeds. When handled these molluscs exude a quantity of violet fluid. They are found chiefly in the Atlantic and Pacific in mid-ocean, but are often cast up on the shores of Ireland and Scotland, and even on the Shetland and Faroe Islands. The species are not numerous.

IBE'RIA was the name given by the Greek writers to Spain. The Iberi are said to have occupied also Southern Gaul as far east as the Rhone (Strabo, Casaubon, 166). They were a distinct race from the Celtæ, who at a remote period crossed the Pyrenees and occupied the central parts of the peninsula, and from whose admixture with the Iberi the Celtiberi sprang. [See CELTIBERI.] Humboldt asserts that the Basque language is the remains of the old language of the Iberian race, which at one time spread over Spain, Southern Gaul, part of Italy, and the islands of Corsica, Sicily, and Sardinia; and he attempts to prove this by the affinity between the proper names in those countries. Strabo observes that the Romans used the names Iberia and Hispania indifferently to denote the whole peninsula.

Iberia was also the name given by the Greeks and Romans to a country south of the Caucasus, having Albania to the east, Colchis to the west, and Armenia to the south, and corresponding to the central or principal part of modern Georgia.

IBE'RIS is a genus of plants belonging to the order CRUCIFERÆ, consisting of annual, perennial, and slightly shrubby species, chiefly inhabiting South Europe and Asia Minor, and particularly the northern shores of the Mediterranean Sea. Two are found in the north of Europe, one of which, *Iberis amara* (bitter candy-tuft), is British. This genus is easily recognized by the form of the corolla and the arrangement of the flowers. Two of the four petals are larger than the opposite pair, the flowers are arranged in a close corymb to form a kind of head, and the sides of the flowers with the larger petals are turned outwards; so that although each flower by itself is irregular and not conspicuous, the combination presents a symmetrical and attractive whole. Various arrangements attaining the same end are found among flowers, for instance among the Compositæ (daisy and dandelion), Umbelliferæ (carrot), Guelder Rose, and Hydrangea. Other peculiarities of the genus are that the stamens are free, without appendages; and the long pod (*siliqua*) is flattened, with keeled or winged valves. The plants have a very graceful appearance, and are cultivated in gardens as objects of ornament, under the name of Candy-tuft, in allusion to their having been procured at an early date from Candia.

The species introduced thence in 1731 was *Iberis sempervirens* (the common rock or perennial candy-tuft), a hardy, evergreen, half shrubby plant with white flowers. In the following year *Iberis gibraltarica* was introduced from Gibraltar; it is a large, handsome evergreen plant with lilac flowers, but does not succeed very well in the open air. From the fact that this species as well as others

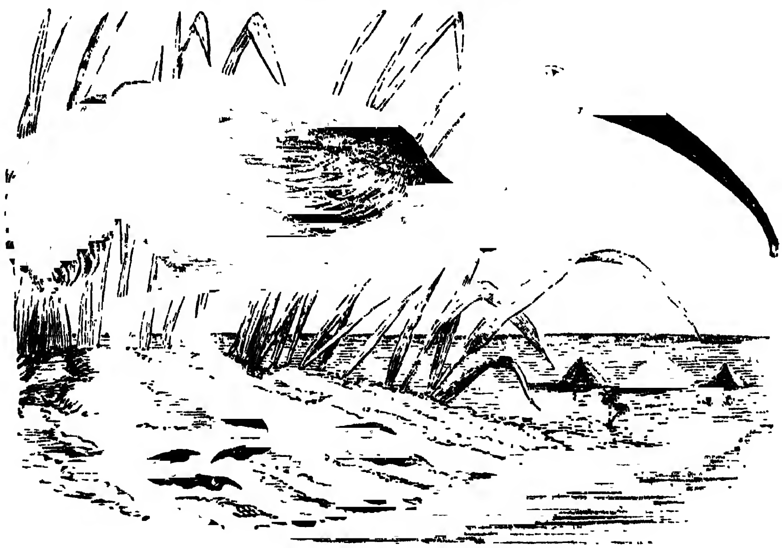
were natives of Spain, the genus received the name of Iberis, from IBERIA. As early as 1596 *Iberis umbellata* was known in English gardens, a hardy plant with purple flowers; and at the present time there are several cultivated varieties grown with lilac, carmine, or crimson flowers. It is a native of the south of Europe.

I'BEX (*Capra ibex*) is a species of ruminant mammals belonging to the genus Capra or GOATS. The ibex or steinboc, as it is sometimes called, inhabits the high

Ibex (*Capra ibex*).

mountainous regions of the Pennine and Graian Alps in Europe, and the mountain ranges of Asia, including the Himalayas. It enjoyed formerly a much wider distribution in Europe, where it is now only saved from utter extinction by the protection afforded it by stringent game laws, together with the inaccessibility of its usual haunts. The Asiatic varieties are considered by some to be distinct species. The ibex is a large, graceful animal, measuring $2\frac{1}{2}$ feet at the shoulder and $4\frac{1}{2}$ feet in length; the Asiatic specimens are larger, attaining a height of $3\frac{1}{2}$ feet. It is provided with immense horns, 3 feet in length, arched backwards, and marked on the anterior face with prominent node-like rings throughout their entire length. The horns of the female are much smaller. The body is covered with a thick fine fur, which is protected in winter by longer soft hair of a yellowish-gray colour on the upper surface and white beneath; a dark brown streak runs along the middle of the back. The male is provided with a short black beard, which disappears in spring. The front legs are shorter than the hind pair. The pursuit of this animal is attended with peculiar danger, as it lives above the line of perpetual snow, descending only at night to graze. Its agility and sure-footedness amid the most dangerous precipices are proverbial.

I'BIS is a genus of Wading Birds, the type of the Ibidinæ, a subfamily of Plataleidæ or Spoonbills. The best known species is the Sacred Ibis (*Ibis æthiopica* or *religiosa*). This bird, called Abou Hannes, or Father John, by the Arabs of Upper Egypt, and Abou Mengel, or Father Sickle-bill, in Lower Egypt, is no doubt the white or sacred ibis, described by Herodotus as "being familiar with man, and having no feathers on the head and neck; white all over, except the head and neck, the tips of the wings, and the tail, which are very black" (ii. 76). In ancient times this bird was regarded by the Egyptians with considerable veneration; it was kept tame in their temples; it was delineated in their sculptures; it was embalmed after death, and mummies of it remain to the present day. The cause of this reverence is attributed by Herodotus to the destruction it annually made among serpents in those parts of Egypt; but the structure of the curved beak, long, slender, blunt at the edges, and roundish



Sacred Ibis (*Ibis æthiopica*).

at the tip, does not appear to render it a very serviceable instrument for such work; and though Cuvier detected the skin and scales of a snake in the mummy of an ibis which he examined, these reptiles do not form its habitual food. Indeed M. Savigny found in the crops of the newly killed specimens which he examined in Egypt only land and fresh-water shells; and these, with worms and soft molluscs, constitute its ordinary diet.

With more reason may we connect the reverence in which this bird was once held to its appearance in Egypt at the time of the annual rise of the Nile. Breeding in the more central latitudes of Africa, the sacred ibis visits Egypt in June, about the summer solstice, and continues during the increase of the waters till September: with the spread of the inundation its numbers increase, and they diminish as the waters subside. On their first arrival the birds repair

to the low lands over which the water is beginning to flow, and as its depth and extent augment they gradually retire to higher grounds, and spread themselves either singly or in small companies along the sides of canals and water-courses intersecting the country; here they may be seen exploring the mud with the bill in quest of food, or sweeping on powerful wings and with a lofty flight from one spot to another, uttering at intervals hoarse loud cries. The sacred ibis is about the size of a fowl, but with longer legs, bare above the joint. When young the neck is partially covered with blackish down, but this soon disappears, leaving the head and neck quite bare, and, as are also the beak and legs, of a decidedly black colour. The general plumage is white, with the exception of the primaries, which are glossy black; a graceful pendent plume is formed by the secondaries, tertiaries, &c.; lower scapulars, black in colour, glossed with bronze, blue, and green.

The Scarlet Ibis (*Ibis rubra*) is a beautiful species, of a bright scarlet colour, with the tips of the wings black. It inhabits the marshes bordering the great rivers of South America. The Glossy Ibis (*Falcinellus igneus*), an allied species, is distributed over nearly every part of the known world, being occasionally seen in this country. The glossy ibis is about 2 feet in length, and the plumage of its upper parts is of a dark reddish or chestnut-brown colour, with beautiful purplish and bronzed green tints. The lower surface and neck are dark reddish-brown, the bill is purplish-brown, and the feet are green. Like many other species of the ibis group it is migratory; it lives chiefly in swampy places by the sides of rivers and lakes, and feeds on young frogs, small fishes, insects, worms, and molluscs. The eggs are of a deep sea-green colour, resembling greatly those of the herons. The WOOD-IBIS (Tantalus) is quite distinct, belonging to the Stork family (Ciconiidæ).

IB'LIS, the Mohammedan Satan. See EBLIS.

IB'RAHIM PASHA, viceroy designate of Egypt, was born in Roumelia in 1789. He was the son or adopted son of Mehemet Ali, and was intrusted by him with the command of a force to preserve tranquillity in Upper Egypt when only sixteen years of age. In 1816 he gave great proofs of gallantry and generalship in subduing the Wahabis, an Arabian sect of military fanatics who aimed at purifying Mohammedanism, and in 1825 he invaded the Morea with the view of quelling the Greek insurrection. He captured several strongholds, but the intervention of the allied powers cut short his successes, and after the battle of Navarino he was obliged to evacuate the country. In the war of 1831 against the Porte he was very successful, and having taken Acre by storm after a siege of six months, he soon made himself master of the whole country. He was appointed governor of the Syrian pashalics, and discharged the duties of his post for several years with rigour and ability. In 1838 hostilities were resumed between Mehemet Ali and the sultan, and Ibrahim was again successful in the field. He totally routed the Turks in the great battle of Nezib, 25th June, 1839; but the interference of the great powers compelled him to relinquish his Syrian conquests and retreat to Egypt. He devoted the following years to agriculture and travel, and in 1848 went to Constantinople and formally received the Egyptian viceroyalty, for Mehemet Ali had become so old and childish as to be quite unfit to govern; but he did not enjoy the honour many weeks, dying at Cairo, 9th November, 1848. He was a brave and skilful general, and a sagacious and stern administrator.

IBRAILA or **IBRAHIL** (Turkish), also called *Brailov*, *Braila*, or *Brailoff*, is one of the principal ports of Roumania, 103 miles N.E. of Bucharest, on the left bank of the Danube, above Galatz. The place is fortified, and an island shelters its harbour. It contains extensive warehouses, and most of the export produce of Wallachia, especially corn, is shipped here. The population is 29,000. The town suffered much in the various wars between Russia and Turkey, and was one of the first places occupied by the Russians in 1877.

IB'YKOS or **IB'ICUS**, an early Greek poet of Samos, at the court of Polycrates, in the middle of the sixth century B.C., of whose work almost nothing remains to us. He is famous as the victim in one of those Greek legends which have become part of our common speech. Schiller's poem "The Cranes of Ibykos" describes the legend in a faultless style. Ibykos was murdered either by assassins set on by rivals jealous of his fame or else simply by robbers—accounts vary. As he expired he called to a flock of cranes overhead to see him avenged. Very shortly afterwards, while yet the murder was fresh in men's minds, one of the murderers present in the theatre of Corinth grew alarmed at something which seemed to threaten him with detection, and at the same moment saw to his horror a troop of cranes slowly straggling into sight. "Behold the avengers of Ibykos," he cried involuntarily. He was at once seized, and was forced to confess the crime and implicate his partners in guilt. "The avengers of Ibykos" was a proverb among the Greeks akin to our "Murder will out." In other versions the avengers are crows, not cranes.

ICA'RIOS or **ICARIUS.** See IKARIOS.

IC'ARUS, or more correctly *Ikaros*. See DÆDALUS.

ICE (German, *eis*) is the solid form of water. Water in ordinary cases freezes at 32° Fahrenheit, or 0° Centigrade and Reaumur. The formation of ice most generally takes place on the surface of the water first, and if the cold be sufficiently intense the formation progresses downwards till the whole body of water is converted into a solid mass. Sometimes, however, ice forms at the bottom of rivers, and is then called ground-ice or anchor-ice. The causes of this exception to the general rule have not as yet been clearly ascertained; but it has been observed that ground-ice, when it is detached from the bottom, rises and floats in the ordinary way. Sea-water, under the most favourable circumstances, does not freeze until its temperature is reduced to about 28·4° Fahr., and the ice when formed contains only one-fifth of the salt originally present in the water. It is one of the universal laws of nature that as all bodies are expanded by heat so they are contracted by cold; but water, which contracts to 39°, or a little above, then suddenly begins to expand, and continues to expand till it reaches freezing-point. Bismuth, antimony, and cast iron behave similarly, the economic value being incalculable, since it enables the iron or antimony when swelling at the moment of solidification to thrust itself into every nook and cranny of the mould, and to reproduce the finest touches of the moulder. A plausible theory is sometimes started to explain why water should on freezing increase in bulk and become specifically lighter on the principles of crystallization (the word crystal, Gr. *krustallos*, originally signified ice). Water in freezing crystallizes in needles, which uniformly cross each other at angles of 60 and 120 degrees (see Plate SNOW); and by this means a piece of ice, on minute examination, will be found full of air-bubbles, or small interstices, which of course contribute to the bulk and decrease the specific gravity. It is this angle of crystallization which causes the ice to occupy a greater volume than if the needles were parallel. To prove that ice contains a large amount of air we have only to drop some small pieces of ice into a glass filled with hot water, and we will perceive that as the ice melts the air contained therein becomes disengaged, and air-bubbles will be seen to rise to the surface of the water and then burst. That ice is lighter than water is known from its swimming on its surface, and also from the fact that the bulk which water occupies when turned into ice is as eighteen to seventeen. Thus this apparent deviation from the laws of nature does not really alter the general proposition, that all bodies are contracted by cold and expanded by heat.

But as to the general density of ice, it is harder and much more compact in the northern latitudes than in the more temperate ones. The ice of Spitzbergen and the Greenland seas is so hard that it is difficult to break with a hammer.

Expansive Force of Freezing Water.—Ice has already been stated to be at least one-seventeenth greater in bulk than water. The comparative incompressibility of water, upon which so many of our powerful hydraulic machines depend, comes therefore very powerfully into play, for from a little above 39° Fahr. down to 32° it is continually and gradually expanding as it cools. Hence the bursting of our water-pipes in a frost, and the fracture of huge rocks by the apparently gentle and yielding water. The great force exerted was shown in the most striking manner by some experiments of Major Williams in Canada. He filled a 13-inch iron bombshell quite full of water, closed the touch-hole with an iron plug weighing 3 lbs., and exposed it to frost. After a little time the iron plug was forced out with a loud explosion and thrown to a distance of 415 feet, and a cylinder of solid ice issued from the orifice 8 inches in length. This was no doubt really water within the bomb, much under freezing-point, kept fluid by the great pressure, but expanding into ice as it sprang forward out of the hole. A second experiment, in which the plug was more securely fixed, resulted in the bursting of the bomb into 100 pieces.

To show at once the strength and the plasticity of ice, it is related by M. de Bomare that during the severe winter of 1740 there was constructed at St. Petersburg, according to the rules of architectural art, a palace of ice 52 feet long, 16 feet wide, and 20 feet high. The blocks of ice were quarried from the river Neva; and when built up the different parts were at once united and coloured by sprinkling them over with water of different tints. To increase the effect six cannons made of ice, with wheels, &c., of the same material, were placed before the palace; and a hempen ball was fired by one of these cannons through a board 2 inches thick at a distance of nearly sixty yards, without bursting the ice cannon. In the northern part of the Russian territory the temperature of the atmosphere is sometimes sufficiently low to freeze mercury, or 71° below the freezing-point of water. In the northern latitude the thermometer frequently falls to Fahrenheit's zero, or 32° below freezing-point (about −18° C.)

Structure of Ice.—Ice is in fact an aggregation of crystals based upon the same geometrical figures as the snow crystals which are shown in the Plates SNOW. The beautiful feathery or fern-like forms which thin pieces of ice yield on melting in water are shown in those Plates, as well as the needle-like structure mentioned above. Or, as Professor Tyndall first showed, a piece of ice may be cut parallel to its planes of freezing and allowed to absorb radiant heat, when beautiful stars and flowers of six arms or petals will begin to show themselves as the structure falls to pieces. This destruction of ice points clearly to its construction as occurring in the converse manner. The close contact of the needles and crystals of the frozen water yields an unbroken clear mass, not only transparent (pervious to light), but remarkably diathermanous (pervious to heat).

Polar Ice.—It is believed on good grounds of inference, but absolutely without positive evidence, that the south pole is covered with a great cap of ice, and some physiographers have gone so far as to assert its thickness as possibly 6 miles at the centre. But as to the ice of the north pole, thanks to the efforts to discover a north-west passage which showed us the breach in the wall of the polar fortress, we know very much more.

A glance at a good globe or at a map of the polar regions will show that, speaking roundly, the great continental masses that make our hemisphere emphatically the land-half of the earth all come to an end close inside the Arctic circle. The Polar Sea, thus inclosed for seven-eighths of its circumference, is open to the Atlantic in its remaining eighth (Behring Strait is too narrow and too shallow to be considered). In this gap, as the traveller sails north, he finds himself at first accompanied by an almost imperceptible current, or "slow indraught," of Atlantic water, carrying from the south a temperature considerably higher than the latitude would otherwise possess, but cooling rapidly. Here, accordingly, the nearest approach to the pole may be made without meeting ice. This indraught gradually parts with its heat, and when it reaches within a few degrees of the freezing-point it suddenly disappears, and gives place to a southerly current of sea-water of 29° Fahr. and considerably less saline. The salt water is now the heavier, bulk for bulk, and consequently the two currents pass through each other and change places, and the salter and less cold current may for a long distance still be traced by deep-sea thermometers. Sooner or later ice is encountered; at first a small decaying fragment tossed by the waves, then lines and patches of "pack," then broad fields with ice-locked pools or "polynia"—Kingsley appropriately called them "peace pools"—and, finally, wherever these have been left behind, a wide white expanse unbroken by a single lead of water. So that surrounding the unknown area there is an outlying zone where the sea gradually gives place to ice. In short, the traveller has crossed the *oceanic snow-line*, and but for the dispersive powers of wind and tide all the ice and snow to poleward of him must for ever cumber the surface of the sea, for the sea is itself below the melting point of snow. Two factors take part in the formation of the new ice, namely, the direct freezing of sea-water and the accumulation of snow. When the sea freezes minute glittering scales of ice form in it and slowly float upwards, till the surface is covered with a yielding paste several inches thick. This soon hardens as the floating crystals raise the entangled brine into a temperature where it, too, freezes, and the floe thus formed in nature's laboratory is salt ice, containing about one-third of the salts of the parent water. Extraordinary misstatements have been made about the freshness of sea-formed ice, because it was assumed that the water necessarily treated its salts as impurities, and expelled them in crystallizing. A snowfall is usually the foundation of the new floe, and under the joint parentage of freezing sea and snowfall it grows, if undisturbed, to a thickness of from 2 to 9 feet. Next year, if not drifted away, it grows something less in proportion as the water is protected by its thickness, and so on, every year getting less and less from the sea, but annually receiving the snowfall. A floe perhaps 15 miles across, and floating 10 or 12 feet out of water, is sufficiently imposing; but a certain amount of scepticism at first attends the calculation that there is of course at least eight times as much of it below. Sir Edward Belcher encountered ice 106 feet thick drifting into and grounding on the shores of Wellington Channel. It was in Banks Strait that Sir Edward Parry was finally stopped by the great undulating floes, reaching 102 feet in thickness, that he tells us he had never seen in Baffin's Sea or in the land-locked channels he had left behind him, but which filled the whole sea before him. Such floes are the edge of a pack which we may conjecture extends uninterruptedly from shore to shore of the Polar Sea. The reason that the snow does not melt on the Polar Sea is that the ice is diathermanous. The rays of the sun pass through it without warming it. On the land the earth is warmed, and in its turn imparts its warmth, so that the curious spectacle is shown in Arctic regions at the end of summer of a land bare of snow and a sea covered with it.

Land Ice, Glaciers, &c.—The formation of ice on the land, as in the glaciers of Switzerland, of Greenland, &c., is substantially conducted on the same principles as the formation of the great Arctic ice-packs. When we

examine any chance exposure of a freshly cleft section of a glacier (or of an ice-pack), it is seen to be faintly, but nevertheless perfectly distinctly, stratified in even parallel bands about a foot deep. The stratification is best seen from a little distance; the blue surface of a section shows regular horizontal lines of darker or lighter shade, depending on whether the air-cells in the transparent ice are far apart or close together and numerous. The strata are deepest at the top of the section, and grow thinner towards the bottom. These strata mark the successive layers of the névé or ice-field of annually accumulating snow that lies in the basins of mountains, or accumulates on the miles and miles of ice-pack.

The conversion of each season's snow into a layer of ice does not depend upon any process of thaw, and as it occurs within a foot or two of the surface it is plain that pressure has little to do with it. It can be traced through every stage. The greater part of the snow falls as an almost impalpable powder, consisting of hexagonal plates and needles, although in the milder weather of spring and autumn it appears in more complicated and often extremely beautiful stars. After a time the crystals most exposed to the cold grow larger; these are of course on the top in autumn and at the bottom in summer. The latter soon grow to resemble hailstones, then unite into irregular lumps and rods like sugar-candy, and finally coalesce into spongy ice. The cause of the growth is easily understood when we reflect that ice crystals evaporate without melting, and that the snow always finds itself interposed between widely differing temperatures.

Ice-flow.—Ice accumulated in a sloping valley—that is, forming a glacier—does not behave as a solid, but as a viscous fluid, say somewhat like very thick treacle. Glaciers do not move down in one block, but flow accommodating themselves to the varying width of their channel and to the inequalities of its bed. Professor Tyndall planted a row of sticks in a straight line across a glacier, and after a few days the line had become a crescent, with the concavity upwards, showing that the middle of the glacier moved faster than the sides, just as in a river, where the stream is stronger in the centre. For the general phenomena of these great ice-rivers, see the article GLACIERS. The viscosity of ice can be very easily shown by cutting a long thin slab of ice, and supporting it on two chairs, when it will, even in a temperature below freezing, gradually bend with its own weight. Two theories have been put forward to account for the apparent viscosity of ice—one, now practically abandoned, that it is a true viscosity; and the other, that it is produced by the known effect of pressure in lowering the freezing-point of water, so that whenever the ice is subjected to great pressure it melts. The water then yields to the pressure, and instantly refreezes in its new shape.

Regelation.—The effect just described yields the phenomenon known as regelation, a remarkable property of ice to which attention was first directed by Faraday and Dollfuss-Ausset independently of each other. If two slabs of ice having flat surfaces are placed together and the temperature of the surrounding air is above freezing-point, the stratum of water between them soon freezes and welds them into one block, and a similar result takes place if pieces of ice are pressed together under water. In the same way, if a block of ice is supported at the ends, and a loop of wire is put over the middle part having a weight attached, the wire will gradually cut through the ice, and yet the block will remain unbroken. The explanation of this curious property of ice was first given by Professor James Thomson, who from a study of the laws of thermodynamics came to the conclusion that since water expands on freezing, its freezing-point must be lowered by increase of pressure, and further calculated that every additional atmosphere of pressure would lower the freezing-point ·012° Fahr. This theoretical conclusion was experimentally tested by his brother Sir William Thomson by means of the piezometer, and found to be exactly correct.

ICE TRADE AND MANUFACTURE. The demand for ice for the preservation of food, for the preparation of articles of diet, such as ice creams and cold drinks, and for manufacturing and medical purposes, has caused a trade to spring up which is of considerable and increasing importance. The practice of storing ice in winter for use during summer is one of great antiquity. It was adopted to a large extent by the ancient Greeks and Romans. Most of the country houses of England of the better class are furnished with ice-houses for storage. Those of old construction are usually built under-ground, on the theory that the atmosphere is colder there than above. The bottom of the ice-house was made to slope towards a sunk drain covered by an iron grating, to permit the water from the melted ice to pass away quickly. It has, however, been found that the exclusion of damp is very important, and that this can be better secured above-ground than below. Ice-houses built above-ground are made with double sides, the space between the walls being filled with some non-conducting material. In the large ice-houses built to store ice for commercial purposes the outer walls are of massive brickwork, and the inner of strong timber; between the two is a compact layer of sawdust or of tan-bark, substances remarkably impervious to heat. The inclosed area is divided into compartments, and the only door, extending from floor to roof, is narrow and closed by a sliding shutter, over which, on the outside, is fixed a crane. When the laden carts come into the courtyard the ice is emptied into one or other of the compartments, where it is strewn about equally layer after layer until the whole place is full. When the ice is stored in large blocks these are kept from freezing into a mass by means of layers of sawdust.

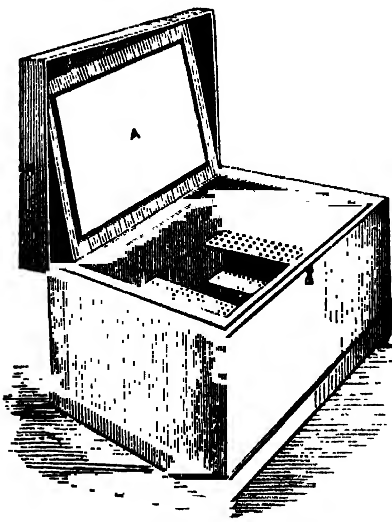
In America ice-houses are always built above-ground without any cellarage, usually upon the shore of the lake or pond where the ice is procured, and as near to the edge of the water as a proper foundation can be obtained for them. Some of the storage houses built by the ice-cutting firms and companies have an immense capacity, many of them holding from 40,000 to 50,000 tons of ice. They are usually square or oblong structures, several of them standing side by side in a row, their gables flush with each other and facing the same way.

The idea of exporting ice appears to have been first put in practice by a Boston merchant named Tudor, who about the beginning of the present century shipped ice to Martinique. Notwithstanding many failures he persisted in the trade, which ultimately became very lucrative, and was extended to many parts of the tropical regions. In India the natives had long practised a very ingenious method of obtaining ice. At a place about 40 miles from Bengal the manufacture was carried out on a somewhat extensive scale as follows:—Pits about 2 or 3 feet deep were dug in the ground, which were lined with the stalks of Indian corn or dried sugar-canes; on the top of these pits, so lined, were placed shallow dishes made of very porous earthenware and filled with soft water; and these being exposed to the air at night would be found covered with ice before the morning, owing to the evaporation from the outside of the dishes. In 1833 Mr. Tudor sent a cargo of ice to Calcutta and sold it at half the price of the native ice, and since that year it has formed a regular article of commerce not only with Calcutta, but also with Madras, Bombay, Hong-Kong, Whampoa, and Batavia. North America may still be considered the greatest ice-producing country, and the trade is one of immense dimensions. The ice there is chiefly collected in the neighbourhood of Boston, Philadelphia, Baltimore, Washington, and New York, and the lakes which supply it are very valuable property. One of the best sources is Rockland Lake, in Orange County,

which yields more than 100,000 tons every winter. Wenham Lake, 18 miles from Boston, is very deep, and the ice forms upon it beautifully clear.

It has been computed that in America 2,000,000 tons of ice are cut and stored every year for the use of New York and the middle states. A large quantity of the Wenham Lake ice was formerly sent to England, but the British supply, and indeed that of nearly all the Continent of Europe, is now obtained from Norway. The Norwegian ice is very hard and pure, and is the best quality in the market. It has been estimated that about 150,000 tons of ice are annually imported into England, of which the greater part is consumed in London.

Ice Chests or Refrigerators.—For preserving food in hot weather, keeping fruit or wine cool, butter hard, &c., an ice chest is a great luxury. Such a chest is provided with perforated sliding shelves under which the ice is placed, and upon which wines, fruits, and provisions are placed and preserved, at a low temperature, without coming in contact with the ice. The chest is constructed like the large ice-stores, with double walls filled up with a



Ice Chest or Refrigerator.

non-conducting substance, as sawdust or charcoal. A and B are the two lids. A, when closed, renders the interior air-tight. B is the outer lid, forming part of the external chest. A block of ice, weighing a few pounds, placed in the bottom of this provender box, will preserve its contents at a uniform temperature, very little above the freezing-point, for several days together.

Artificial Ice.—Notwithstanding the large and increasing trade in ice, and the immense natural supply that has been found available, the attention of inventors has been directed for many years to the construction of ice-making machines.

The best types of these ice-making machines produce large blocks of ice in any desired thickness. The cost of manufacture varies from 5*s.* to 10*s.* per ton of ice, according to the size of the machine employed. The principle of this process of ice-making is the evaporation of a volatile liquid *in vacuo* (sulphuric ether is generally used) to produce cold, and the employment of the same liquid continuously without appreciable loss. The following is the action of the apparatus:—The vapour pump is worked by a steam engine or other motive power, the air pump maintaining a constant evaporation of the volatile liquid in a hermetically-closed chamber filled with rows or series of tubes through which a current of salt water (used because it remains fluid at a low temperature) is passed; the cold produced by the evaporation cools the salt and water passing through the tubes, which is then circulated round vessels or ice moulds containing the water to be frozen. After travelling thus, the brine is again returned to the evaporating chamber, and passing through its tubes it parts with the heat abstracted from the water in the ice moulds. It is then, as at first, again conducted round the moulds, until the water in the moulds is converted into ice. While the cooling of the brine, or carrier of cold, is proceeding, the ether vapour drawn from the refrigerator by the vapour pump is passing into a similar class of chamber, fitted with tubes, styled the condenser; these tubes are surrounded by water, and on the entry of the ether vapour it is reduced to its liquid state again, and returned to the evaporating chamber for refrigerating purposes. It will be seen from this description that the process of ice-making by this method is extremely simple and inexpensive. The same ether and brine being used over and over again, little or no expense incurred further than the steam power for working the pump, and an attendant for the machine; 52 degrees of cold, that is to say, $-20°$ Fahr., 20 degrees below Fahrenheit's zero, have been thus obtained. When a skating rink is formed of real ice artificially produced, the refrigerating brine is driven through a series of horizontal pipes laid upon a water-tight floor and covered to the required depth with fresh water, which it congeals into an even surface of ice.

By means of ether ice-making machines ice is regularly produced nearly under the equator in Peru, and similar machines are used by the British government at the stations for troops at the Cape and in many parts of India. A simple machine, in which the volatile liquid used is the aqueous solution of ammonia, has been designed by Carre & Co. of Paris, and an improved form of the ammonia machine was patented by Reece in 1869. A later adaptation of ammonia is found in Linde's ice-making machine exhibited at Düsseldorf in 1880, and a machine in which ice was produced by the evaporation of water under a deep vacuum, the only chemical substance used being sulphuric acid, was exhibited in London in 1882.

ICE, AS A GEOLOGICAL AGENT, not only effects the disintegration and erosion of the surface of the earth, but also the transportation of the debris and its subsequent deposition. Disintegration is chiefly effected on the formation of the ice by the freezing of water in the interstices of rocks. Glaciers are the great denuders; while transportation and deposition are effected by glaciers, icebergs, and shore ice.

Ice is formed under two conditions:—

(1) On land areas it is produced by the consolidation of snow in mountain districts, the snow passing first into the condition of *néré* or *firn*, and then into compact ice, which forms the mass of the *ice sheet* and *glacier*, and of their offshoots, *icebergs*.

(2) On water areas it is produced by the freezing of the surface, forming river and lake ice in fresh water; and in sea water the *ice-foot* and *ice-floe* or pack ice. The bottom layer of water sometimes freezes under favourable conditions, producing bottom ice, ground ice, or anchor ice. All these have a certain function as geological agents.

The disintegration of rocks by frost is most apparent in mountain regions, or in districts subject to a wide range of daily temperature; here the expansions of the water on its passing into ice fractures the rocks, and when they are in an insecure position, they fall away on the subsequent thawing. The *talus* found at the base of most cliffs is formed in this manner, but when a glacier passes along the foot of the cliff the debris falls on to the glacier, and is carried off as a file of blocks or *lateral moraine*.

The erosion of rock surfaces by ice is effected almost

exclusively by *ice-sheets*, or the widespread sheet of ice which covers the land in high latitudes, as Greenland, and by glaciers, which are often the prolongation of the ice-sheet down fiords, &c. See GLACIERS and ICE AGE.

The transportation and deposition of material by ice is effected by glaciers, icebergs, shore ice, and bottom ice. The first of these has already been fully considered. When a glacier or extension of an ice-sheet reaches the coast, a prolongation of ice is pushed out to sea; this at first presses along the bottom, but on the water becoming sufficiently deep it is buoyed up, and eventually the extremity becomes detached. This detached floating mass of ice is an *iceberg*, and sometimes contains on its surface a portion of the original glacial moraine; it is carried off with its load of earth and stones to lower latitudes. As it melts its centre of gravity becomes altered, its position readjusted, and its burden of debris is deposited along the floor of the ocean. These bergs are sometimes met in the North Atlantic as far south as 40° N. lat. Their size must be enormous; masses have been seen projecting 200 or 300 feet above the sea, and owing to their specific gravity this can be only one-seventh or one-eighth of their total thickness—they must be upwards of 1400 or 2800 feet in depth. In Norway icebergs are only produced at Jokuls Fiord, but the great source in the northern hemisphere is the ice-sheet of Greenland, where it reaches the sea through the numerous fiords on the coast. In the southern hemisphere huge bergs are given off from the Antarctic ice-sheet, and in South America glaciers enter the sea as far north as 46° S. Although the chief function of icebergs is transportation and deposition of materials, yet in some cases they do effect a small amount of erosion, as when they ground on shallows, or are pressed against projecting bluffs and headlands.

In cold districts, along the edge of the water a fringe of shore ice is often formed; this is the *ice-foot*. It incloses shingle from the shore, and on its surfaces masses of rock and other debris fall from the adjoining high ground. On this shore or coast ice becoming detached and floating away it transports with it the shingle, blocks, and other debris. These are distributed over the floor of the ocean as the ice melts. On the surface of the sea in these districts *floe-ice*, or the *ice-floe*, is formed; it seldom contains any extraneous debris, but on breaking up under the action of wind and tide the masses become piled together, forming the *ice-pack*; this, when forced up the beach or urged against the cliffs, effects a small amount of erosion and transportation. At the bottom of lakes and rivers in some places ice forms; this variety is known as *anchor ice*, *bottom ice*, or *ground ice*. It usually entangles pebbles and stones that, on its rising and floating off, are carried with it.

ICE AGE is one of the names which is applied in geology to that portion of the CAINOZOIC EPOCH wherein those varied superficial accumulations, collectively known as drift, with their associated phenomena, were developed. The deposits and formations most usually ascribed to glacial agencies are:—Heterogeneous accumulations of clay, sand, and gravel, containing angular and subangular stones, which often differ considerably from the adjoining rocks; in mountain districts, moraines; and around centres of dispersion, drumlins, &c.; boulders, erratic blocks, *blocs perchés*, and other transported fragments of rock; rock basins and glacial lakes accumulated behind moraines and other glacial debris; cirques, corries, and cooms; *roches moutonnées*, polished and striated rock surfaces, striated loose stones, crag-and-tail structures, &c.

These phenomena are confined to the higher latitudes, and although varying locally they are all ascribable to an extension of the rigorous conditions now confined to Polar and Alpine regions. This ice age or glacial period affords evidence of there having been a gradual refrigeration of climate, when the North Polar ice-sheet, becoming enlarged, advanced southward, and instituted Arctic conditions in districts previously temperate or even subtropical. At the culmination of the intensity in glacial conditions the land surfaces of the northern hemisphere, to about the forty-fifth or fiftieth degree of north latitude, were enshrouded in ice, which, working probably on a previously much disintegrated surface, modified the then existing physical features, and moulded out the present flowing outlines of our hills; leaving, as evidence of its former wide distribution, a heterogeneous accumulation of boulders, gravel, sand, and clay. These are sometimes stratified, although usually only very rudely so; but more commonly the deposit is an irregular massive conglomeration.

On the European continent the evidences of glaciation extend through Scandinavia, Denmark, Holland, North Germany, and over the major part of Great Britain and Ireland, but decline on proceeding eastward. The evidence of the British Isles having been covered by a moving ice-sheet appears indisputable, and the boulder clays are probably the products of this, although formerly they were supposed to have been deposited in the sea by icebergs laden with moraine matter, or it has been supposed that they were formed in the sea beneath an ice-sheet. But of late years the tendency has been, as Sir A. C. Ramsay says, "to attribute the origin of all or almost all of the British boulder clays to the direct action of glaciers, and to look upon them as *ground-moraine* matter, the *moraine profonde* of Swiss and French authors, which is supposed to have a modern parallel in the vast quantities of debris believed to underlie and be pushed forward by the mighty ice-sheet that passes seaward from the great basin of central Greenland, and finds its vents through unnumbered fiords into Baffin's Bay." This sheet of ice appears to have had its southern limit at a line extending across Middlesex, southward of Wales, and on to the southward of Ireland. In Great Britain centres of dispersion were formed by the Highlands of Scotland, and smaller ones were produced by the hills of Cumbria and Wales. In Ireland centres of dispersion were formed by the north-west mountain area (Donegal), by the Connemara Mountains, and by the mountainous district of the south-west. Scandinavian ice appears to have spread out over the North Sea, reaching even to East Anglia, but the main mass passed out to the north of Scotland.

In North America there are abundant evidences of an intense glaciation; the phenomena are most pronounced to the east, and decline on proceeding west, but reappear on the Pacific coast. It is evident the succession of events was similar to that of the British Isles. In the southern hemisphere, exclusive of the Antarctic continent, which is enshrouded in ice, but a comparatively small portion of land extends within the probable region of glaciation. These lands would be Patagonia, parts of Tasmania, and New Zealand; in the latter we have abundant evidence of the former wide extension of the glaciers.

An Arctic fauna and flora preceded this advancing ice sheet, and the native occupiers were compelled for a time to migrate to more congenial climates, from whence, on the amelioration of conditions, they returned towards their original habitat, while the intruded denizens retreated to more rigorous latitudes or ascended to higher altitudes. The retrocession of the ice appears to have been intermittent, and similar conditions were probably introduced successively in different latitudes. In equatorial regions no glacial deposits occur, while in polar regions probably all the superficial accumulations have more or less a glacial stamp. In intervening districts an intermingling of glacial and nonglacial deposits is found. These are very various both in structure and composition, local peculiarities being frequent, especially towards the lower limit of the former ice extension. These accumulations are unlike ordinary

sedimentary strata in many particulars, and their relative age cannot be strictly inferred from their superposition, nor can similar structural deposits in separated districts be considered of precisely the same age.

In the British Isles the glacial deposits have been separated into three main subdivisions, which Sir A. C. Ramsay sums up as follows:—"On the whole, also, it would appear that the complete glacial deposits of the east of England consist of lower and upper boulder clays, between which there lie stratified sands and gravels containing sea shells, and that these strata were deposited in the sea during a temporary intermission of the cold of a glacial epoch. Shells, sometimes fragmentary and sometimes entire, are also found plentifully enough in the boulder clays of Holderness and elsewhere."

These subdivisions are in a great measure structural; locally they are not uncommonly well marked, although not recognizable in all districts, especially on advancing north and in mountainous regions. The various members are best developed in East Anglia.

Lower Glacial Beds, or Lower Boulder Clay, attain a maximum thickness of 200 feet. It is a stiff clay, containing angular and subangular stones and pebbles, being more gravelly towards its base when resting on hard rock. Through this mass there are small patches of aqueous deposits, such as sands, gravels, &c., horizontally or obliquely stratified, and often showing much false bedding, indicative of varying currents.

Middle Glacial Beds, or Middle Drift, consist chiefly of sands, gravels, silts, &c., with seams of boulder clay and brick earth; they differ much in thickness, the maximum being about 70 feet. Those peculiar long winding gravelly ridges, known as *eskers* in Ireland, *kames* in Scotland, and possibly the *osar* of Sweden, most probably belong to this series. See Esker.

Upper Glacial Beds, or Upper Boulder Clay, are for the most part very local deposits. Besides the deposit of boulder clay, the phenomena of local glaciation may be referred to this period, where from elevated districts the remnants of the glaciers were the last to disappear, and at the close of which much of the accessory phenomena were uncovered, the moraines abandoned, and the drums and drumlins moulded. See Boulder Clay.

Fossil organic remains are not abundant in glacial deposits. Those that do occur belong mostly to species of shells still living in British or adjacent seas; most are, however, now of rare occurrence, being met chiefly towards the north of the British Isles, or about Norway, Greenland, or Spitzbergen. Thus *Pecten islandicus* is now confined to Arctic seas; *Astarte elliptica* occurs off the Scotch coast; and *Fusus fabricii*, found in the Irish drifts, is an Arctic species. Other shells are *Natica Grœnlandica*, *Fusus scalariformis*, *Scalaria Grœnlandica*, *Cemoria Noachina*. The species *Cyrena fluminalis*, a river shell, is now confined to the Nile and other African streams. Some of these shells have been found in the drifts on some high districts, as Moel Tryfaen in North Wales, at an elevation of 1350 feet; in Cheshire, at 1200 feet; in Scotland, at 524 feet; and in the Dublin Mountains, Ireland, at a height of 1200 feet.

In the mammalian remains there is a peculiar admixture of northern and southern faunas. Thus we find that the hairy mammoth (*Elephas primigenius*) extended into Italy; the reindeer (*Cervus tarandus*) to Switzerland; the musk sheep (*Ovibos moschatus*) and Arctic fox (*Canis lagopus*) to the Pyrenees, and the glutton (*Gulo luscus*) to Auvergne. Associated with these are the remains of the lemming (Myodes), porcupine (Hystrix), leopard (*Felis leopardus*), African lynx (*Felis caracal*), lion, cave hyæna (*Hyæna spelæa*), African elephant, hippopotamus, and rhinoceros.

There appears to be no direct evidence of the presence of man in Britain either before or during the glacial period; he probably had tenanted other parts of the globe, but being naturally a naked animal it is to be supposed he originated in some warmer climate and migrated northward subsequently.

Throughout the boulder clay there are indications of temporary retirements of the ice and of the probable amelioration of climate with the institution of warmer interglacial periods. The phenomena relied on to support this are, the layers of peat, sand, gravel, and fine clay, formed on different horizons, and the admixture of tropical and Arctic faunas. Of these Sir A. C. Ramsay says:—"It was for some time the fashion to attribute the occurrence in such superficial deposits of what may be called *conflicting faunas*, to the annual changes of summer and winter temperatures. In this way it was attempted to account for the presence of lions, hyænas, hippopotami, &c., in strata supposed to be precisely of the same age with those that contain the bones of reindeer, mammoths, musk sheep (*Ovibos moschatus*), and white bears. When the glaciers and the cold declined in summer, and the ice disappeared from the rivers, then the hippopotami made a raid to the north, accompanied by lions and hyænas, and when the winter cold returned they retreated further south, leaving such snowy land as there was in exclusive possession of white bears, musk sheep, reindeer, and perhaps hairy mammoths with a warm coat of wool beneath the long hair. But with the advance of research interglacial episodes began to be established, when, in the language of Mr. James Geikie, there took place 'a great recession of the confluent glaciers consequent upon a change of climate.'"

Subsequently the land underwent such depression as converted the British Isles into an archipelago. From the small patches of land which appeared above the ocean, numerous small glaciers gave birth to icebergs, which on melting distributed their freight of debris over the floor of the ocean. At this time much of the sands and gravels of the middle drift series were formed, mostly from boulder clay, by the action of the waves. The eskers, kames, and osar were also formed at this time, probably in wide shallow seas with conflicting currents. The amount of depression must have been very great, judging from the altitudes at which marine shells are found; but it is difficult to conceive such an unstable crust to the earth as would be indicated by such sudden alterations in the relative level of sea and land within comparatively short periods.

Much of the gravels found in glacial deposits were probably produced by infraglacial streams, or in such places as where the glacier terminated in the sea; there, as the ice became buoyed up by the water, the waves and currents acting on the transported debris would remove the finest portions, and by abrading the angular fragments produce sands and rounded gravels. In North America there appears to have been a pluvial period, in which there were great downpours of rain, with swollen and tumultuous rivers.

On the re-elevation of the land severe conditions again set in to a partial extent, but the glaciers were smaller and more local, being mostly confined to high mountain groups, which thus underwent a second glaciation. Previous accumulations were then disturbed and rearranged by these local glaciers and rivers. A gradual amelioration of climate ensued, local glaciers shrank and finally disappeared, the present conditions of things being thus instituted. This succession of events is thus described by Sir A. C. Ramsay when describing the glaciers of North Wales:—

"I shall take the Pass of Llanberis as an example, for there we have all the ordinary proofs of the valley having been filled with glacier ice. First, then, during and after the time of the great ice-sheet, the country to a great extent sank below the water, and drift was deposited, and must more or less have filled many of the deep narrow valleys of

Wales, and which still remains in part in some of the broader expanses of the country. When the land was rising again, the glaciers gradually increased in size, although they never reached the immense magnitude which they attained at the earlier portion of the icy epoch. Still they became so large that such a valley as the Pass of Llanberis was a second time occupied by ice, which, without invading Anglesea, spread itself into the lowlands beyond, and the result was that the glacier ploughed out the drift and loose rubbish that more or less cumbered the valley. Other cases, such as those of Nant-ffrancon and Aber, could easily be given. By degrees, however, as we approach nearer our own days, the climate slowly ameliorated, and the glaciers began to decline, till, becoming less and less, here and there as they died away they left their terminal and lateral moraines, still in some cases as well defined as moraines in lands where glaciers now exist."

The ice age or glacial period was a remarkable episode in geological history, and it is most difficult to determine whether or not analogous phenomena have occurred in previous geological times. Glacial records are liable to be either entirely effaced by denuding agents or so altered as to be rendered unrecognizable. Nevertheless, on more than one horizon of the geological record beds occur that are considered to be characteristically glacial. Thus beds of Miocene age bear this stamp near Turin, although equivalent strata in the Alps and Carpathians contain subtropical organic remains. Peculiar conglomerates and breccias also occur in the Eocene, while in the Chalk erratic pebbles are found, almost the only conceivable transporting agency for which is floating ice, and Sir A. C. Ramsay maintains that some of the beds in both the Permian and Old Red Sandstone formations are of glacial origin.

The Circumstances likely to alter the Climate of the Earth.—The probable cause of the peculiar conditions that brought about a glacial climate has given rise to numerous theories. Some of these we can only briefly glance at.

Any inquiry into the cause of the glacial climate is inseparably connected with a consideration of the climatic changes during past geological time. There is now little doubt that these have varied immensely; but were it not for the records left of the glacial period, it would appear that climates in past time were much more genial than of late, for there are evidences of tropical and subtropical conditions, even in high latitudes, as recently as Miocene times.

To examine the subject of geological climates, even superficially, would require more space than can be here allotted to it; but details may be obtained in Croll's "Climate and Time," Geikie's "Great Ice Age," or Wallace's "Island Life."

Among the theories advanced, some are dependent on alteration in terrestrial conditions, others are based on astronomical causes. In either case much ingenuity is required to propound a theory that will account for several of the phenomena preserved from glacial times, and which are often apparently quite discordant. The occurrence of marine shells at high elevations affords evidence of great alterations in the relative level of land and sea during comparatively recent times; and the intermingling of faunas is indicative of great changes of temperature within comparatively short periods.

Alterations of conditions that might be supposed to produce changes of climate may be either terrestrial or extra-terrestrial.

Terrestrial changes might be due either to changes in the position of the earth's axis of rotation within the body of the earth, or to changes in the geography of the earth.

Extra-terrestrial causes might be due either to alterations in the amount of extraneous heat, to alterations in the obliquity of the ecliptic, to alterations in the form of the earth's orbit, or to alterations in other circumstances of the earth's orbit.

(*a*) *A change in the geographical position of the poles* apparently offers an easy solution to the problem of climatic change; as for such a state of things as prevailed over the British Isles during glacial times we might imagine one of the poles transferred to their vicinity. The poles may change their position in the body of the earth to some extent, but their greatest possible wanderings would be quite inadequate to produce a glacial period. Mr. G. H. Darwin has shown that since the earth became practically solid there has only been a slight possibility of the poles becoming shifted in the body of the earth; even enormous changes in the distribution of land and water would effect but a slight polar displacement. Allowing the permanency of oceans and continents, these changes become impossible. The maximum change of polar position that would be produced by the formation of the Pacific depression would not amount to three degrees of latitude, or 210 miles; while the elevation of the Europe-Asia area since early Tertiary times could not have altered the position of the axis one degree, or moved the poles 70 miles.

Such a supposition as the sliding of the earth's crust around its nucleus, to any extent that would appreciably affect the present question, is only a speculation, against which there are strong objections.

(*b*) *Changes in the geography of the earth* were formerly considered as sufficient cause for glacial climates. It was then considered that by massing the land areas in the tropics, the rest of the globe being covered by seas, severe climates would be done away with; while by supposing land surfaces confined to the poles, they would be subjected to very rigorous climates, and even in equatorial regions comparative coolness would prevail. These suppositions were merely hypothetical, and it appears very doubtful if the proposed distribution of land and sea would have the effect anticipated. Besides, we have good reason for considering that the position and general form of our oceans and continents were sketched out at a very early date in the earth's history.

(*c*) *An alteration in the amount of extraneous heat* received by the earth might be produced by an alteration in the amount of either star or sun heat.

(1) Any variation in the amount of star heat could only be produced by the solar system passing within such a distance of some hotter or colder star that it could be influenced by its radiation. The so-called temperature of space cannot be much above absolute zero—*i.e.* 460° below Fahrenheit's zero; star heat is the only possible source to prevent its falling to absolute zero. If the solar system had passed near either a large hot or cold body, perturbations should have been produced in the planets that would be still noticeable.

(2) Variation in sun heat requires the sun being a variable star. There are good reasons for believing that he has been gradually cooling, and it is not unlikely he has been subject to cold fits. The opponents to this theory argue that a decrease of sun heat, by checking evaporation, would militate against the formation of large snow-fields, and therefore of glaciers, while an increase of sun heat would render a large portion of the earth altogether uninhabitable.

(*d*) As to *variations in the obliquity of the ecliptic* to the plane of the equator. At present this obliquity is about 23° 27′; that is to say, the axis is inclined to the plane of the orbit at about 66° 33′. In conjunction with the revolution of the earth round the sun, this inclination produces the phenomena of the seasons. A decrease in the inclination would render opposite seasons less different, while an increase of obliquity would produce greater extremes by slanting over the poles so as to receive the sun's rays more directly at one side and more obliquely at the opposite side of the orbit. The variation, however, in the obliquity of the ecliptic (we are neglecting those minute

variations due to nutation, &c.) is very limited (the inclination varying only from 24° 35′ 58″ to 21° 58′ 36″), but even this possible change would sensibly alter the amount of heat received at the poles. This cause, however, acting alone, appears quite incapable of producing a glacial climate.

(*e*) ***An alteration of the form of the earth's orbit*** has been appealed to as the cause, directly or indirectly, of past variations in geological climates. As this agency has been received with more favour by scientific men than any of the preceding, the theories in connection with it demand more than casual mention.

The orbit of the earth is an ellipse, the sun occupying one of the foci: by slow secular variation the eccentricity of this orbit constantly varies, the orbit becoming either more nearly circular than at present or more ovate. The eccentricity of the orbit is now about one-sixtieth, but it may have been five times as much, or one-twelfth.

An alteration in the form of the earth's orbit will affect the amount of heat received from the sun in a year by the earth as a whole in the following manner: the axis major of the earth's orbit being constant, the amount of heat received by the earth in one year from the sun is inversely proportional to the area of the earth's orbit, and therefore to the axis minor of that orbit. However, the difference in temperature between maximum and present eccentricity would not amount to more than $1\frac{3}{4}$° Fahr.

(*f*) ***An alteration of other conditions of the earth's orbit.*** While passing through that portion of the orbit in proximity to the focus occupied by the sun, the earth is said to be in *perihelion;* when passing through the portion most remote, it is said to be in *aphelion.* As the amount of heat received by any body in a given time varies inversely as the square of its distance from the source, it follows that the amount received by the earth in a given time during perihelion must be far larger than that received in the same time during aphelion, other conditions being alike. But the total amount received while describing a given angle near perihelion and near aphelion is the same, owing to the more rapid transit of the earth when in proximity to the sun.

The seasons being produced by the earth traversing its orbit with the axis of rotation inclined to the plane of that orbit, opposite poles being presented towards the sun at opposite portions of the orbit, it follows that that hemisphere whose winter occurs in perihelion has the seasons moderated, while the opposite hemisphere, whose winter is in aphelion, has them intensified. Under existing conditions the eccentricity of the earth's orbit is one-sixtieth: the axis of rotation is inclined at about $66\frac{1}{2}$ degrees to the plane of the orbit. Summer, in the northern hemisphere, occurs while the earth is in aphelion; that is, in the height of summer the earth is most removed from the sun, but the north pole being bent over towards the sun receives his rays more directly, the axis of rotation making with the line joining the sun and earth an angle of 66° 33′. This hemisphere is therefore subjected to moderated seasons, the southern being subject to intensified seasons.

These conditions have not always prevailed. The attraction of the moon and of the sun on the spheroidal body of the earth tends always to pull the axis of rotation aside, so that at the end of each annual revolution its position is not parallel to what it was at the commencement. This produces a constant change in the position of the line of solstices (and in the line of equinoxes at right angles thereto). This movement (precession) takes place in the same direction as the hands of a watch, which is opposite to that of the earth round its orbit. The line of solstices gets right round in about 26,000 years; but the line of apsides, or the line joining perihelion and aphelion, has a revolution in the reverse direction to this movement, which is complete in about 110,000 years. It is of course only during the coincidence of the line of solstices and line of apsides that the summer and winter seasons occur in perihelion or in aphelion. But the two movements, the ***precession of the equinoxes*** and the ***revolution of the apsides***, being in opposite directions, complete a cycle of about 21,000 years, at the beginning and termination of which the line of solstices and line of apsides are parallel. During the cycle the seasons will of course be changed also; thus as our winter occurs now at perihelion, 10,500 years hence conditions will be reversed, and it will take place during aphelion, and at the completion of the cycle (21,000 years) it will have returned to its present arrangement.

During high eccentricity the difference in the relative intensity of the seasons on opposite hemispheres must have been largely increased. This, combined with a maximum of obliquity of the ecliptic. is considered to have caused physical actions to combine and induce a glacial climate. But as the equinoxes revolved several times during the last period of high eccentricity, alternate glaciations of the northern and southern hemispheres were produced every 10,500 years. These were more or less severe in proportion as the eccentricity was greater or less during the winter-in-aphelion period of either hemisphere.

To these alternating conditions Dr. Croll ascribes the apparently anomalous mixture of faunas, and writes of the interglacial periods as follows:—"When our hemisphere is under glaciation the other is enjoying a warm and equable climate. But, owing to the precession of the equinoxes, the condition of things on the two hemispheres must be reversed every 10,000 years or so. When the solstice passes the aphelion, a contrary process commences; the snow and ice gradually begin to diminish on the cold hemisphere, and to make their appearance on the other hemisphere. The glaciated hemisphere turns by degrees warmer and the warm hemisphere colder, and this continues to go on for a period of 10,000 or 12,000 years, until the winter solstice reaches the perihelion. By this time the conditions of the two hemispheres have been reversed; the formerly glaciated hemisphere has now become the warm one, and the warm hemisphere the glaciated. The transference of the ice from the one hemisphere to the other continues as long as the eccentricity remains at a high value. It is probable that during the warm interglacial periods, Greenland and the Arctic regions would be comparatively free from snow and ice, and enjoying a temperate and equable climate."

During the long inclement aphelion-winter snow would probably accumulate to such an extent that the short though hot perihelion-summer would be quite incapable of melting it. The heat of the sun would be largely expended in melting the snow, and by a large proportion of its rays being reflected back from the surface of snow and ice, instead of being absorbed or converted into radiant heat. The low temperature thus induced in the lower atmosphere would, by the condensation of aqueous vapour, produce mists and fogs, which would still further reduce the temperature by cutting off the sun's rays.

Oceanic currents have a remarkable effect on the climate of the globe. The great currents of the ocean are considered to be largely due to the action of air currents or trade winds (as well as to differences in temperature of the water itself). This circulation of the atmosphere is produced by the difference in temperature between equatorial and polar regions. In the torrid zone the heated air ascends and flows towards the poles, where it becomes cooled and deprived of its moisture. This cold arid air returns towards the equator impinging on the oceans. The most energetic atmospheric currents flow to and from that pole whose temperature differs most from equatorial regions. During the glacial period, when the temperature of the north polar regions was much lower than now, it is

probable that the air currents were intensified, and that the southward-flowing air current invaded the southern hemisphere; if so, it would push the main westward equatorial ocean current of the Atlantic, which originates the Gulf Stream, further south; if it were of sufficient force to deflect this current south of the most eastward projection of South America, Cape San Roque, then the current would flow into the southern hemisphere, and the North Atlantic being deprived of such a large volume of heated water, its adjoining shores would be considerably lowered in temperature.

There can be little doubt that high eccentricity would tend to produce climatic extremes in that hemisphere where the winter occurred in aphelion, and that, under the present constitution of things, with a combination of the preceding physical agencies, Arctic conditions would extend to lower latitudes.

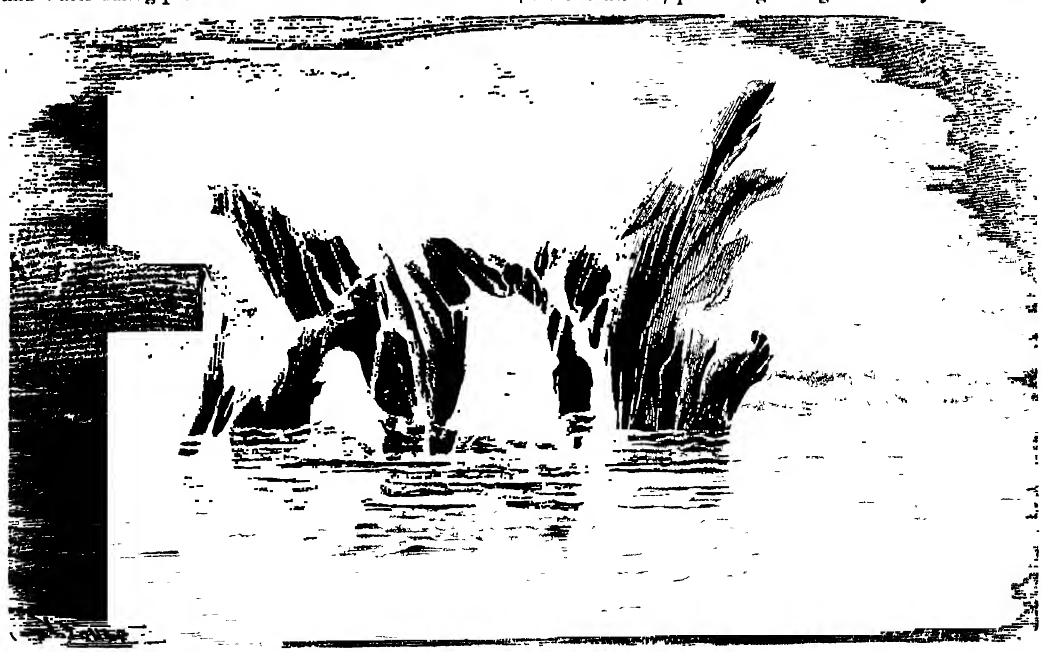
The glacial deposits being of a very limited thickness when compared with formations of ordinary sedimentary origin, and being mostly accumulated on land-surfaces, they would be subjected to the denuding forces, and either removed altogether, or so rearranged and altered as to be altogether unrecognizable as of peculiar origin. Yet the geological record preserved in north polar regions is undoubtedly that of a much more genial climate than anything at present known there, or even existing in much lower latitudes, so much so that many maintain that the Arctic regions are in an abnormal condition, which was only instituted at the commencement of the ice age.

For these reasons, especially the absence of recurrent glacial evidence and the undoubtedly more genial climate in Arctic regions during past geological time, Mr. Wallace considers high eccentricity, with the involved combination of physical agencies, as inadequate to account for the various phenomena. He considers that the distribution of land and water during past time has so modified conditions as to alter the effect altogether. Mr. Wallace is a warm advocate of the permanency of continents, and considers that the northern hemisphere has always exposed a greater area of land, the southern hemisphere being a water hemisphere; from the peculiar distribution of land and water the north hemisphere has always been much warmer than the south, and that into it the great equatorial currents of the ocean have always set. Now, the great continental areas being permanent in position, although gradually but intermittently increasing in extent, it follows that the ocean channels may have become more confined or altogether blocked. In this way the supply of equatorial warm water may have become limited or altogether stopped, and what in past time had been capable of modifying, or perhaps even neutralizing the effect of high eccentricity in the northern hemisphere, had become so curtailed as to be quite ineffectual when the astronomical causes which instituted the ice age set in, and therefore rigorous conditions, such as had not previously prevailed in the north, were felt.

The preceding is a brief sketch of present opinions on the glacial climate; until the geological record is more fully explored throughout the world a theory accounting for phenomena in more detail cannot be expected.

ICE PLANT (*Mesembryanthemum crystallinum*), a garden plant which derives its name from the numerous watery vesicles, forming crystalline spots, like specks of ice, that cover its leaves. It is a native of the Canary Islands, Greece, and the Cape of Good Hope. Large quantities are burnt in the Canaries, and the ashes imported into Spain under the name of *Barilla Moradera*. The plant was introduced into English flower gardens from Greece in 1775. It is easily cultivated; a light sandy loam suits it best.

ICEBERGS (*ice*, and German *berg*, a mountain) are immense masses of ice rising to a great height above the level of the sea, presenting a singular variety in form and



Floating Ice Mountains, with Galleries.

appearance. They are masses broken off from glaciers, or from barrier lines of ice-cliff, and owe their origin to the circumstance of glaciers being in a continual state of progress. Glaciers reach the sea-shore in many places in the Arctic regions. When pushed forward into deep water, vast masses are lifted up by their inherent buoyancy, and, broken off at the landward end, are borne away by the winds, or on tides and currents, to parts of the

sea far removed from their place of formation; if into warmer regions, they gradually melt away and disappear; if met by a warm current and melted below, they become top-heavy and perform a series of somersaults; if arrested in shallow water, they tear up the bottom for a space, and then fall over, depositing, it may be, on the shore-line any blocks, stones, earth, or animals which may have been upon them. The polar bear and polar fox have thus been borne to far-distant shores. The transporting power of a large iceberg is prodigious, and there seems no other way so plausible of accounting for some remarkable geological effects—for instance, the vast masses of Scandinavian rocks, some larger than a good-sized cottage, which are found upon the plains of North Prussia. But unless hard rocks should happen to be entangled in the ice at the base, such floating icebergs grinding along rocks on an exposed shore would not have much power to polish or striate the surface along which they passed. Owing to the expansion of water when freezing, and the difference in density between salt and fresh water, the usual relative density of sea-water to an iceberg is as 1 to ·91674, and hence the volume of ice below water is about nine times that above the surface. This is on the supposition of uniformity of shape, for if the breadth of base much exceeds that at the top, the thickness below water will be much less than if the form was regular. It is chiefly by the north polar current, which passes through the narrow sea that separates Greenland and Iceland and descends upon the shores of Labrador, and thence to the south-east of the great Atlantic, that the ice-formed mountains of the northern regions are borne to the south. The largest icebergs are, however, met with in the Southern Ocean; several have been ascertained to be from 800 to 1000 feet in height, and the largest are nearly 3 miles long. One was met with 20° south of the Cape of Good Hope, between Marion and Bouvet Isles, which was 960 feet high, and therefore more than 9000 feet, or 1¾ mile in thickness. The masses of ice by which the ocean is thus traversed appear in a great variety of shapes, sometimes in the form spoken of, as *icebergs;* at others as vast sheets of ice, called *ice-fields;* or smaller aggregations, known as *ice-floes.* Icebergs are sometimes so numerous that Dr. Scoresby counted 500 drifting along in lat. 69° and 70° N. The great distinction of icebergs from the salt-water ice-fields, independently of their shape, is that the former are fresh-water formations, which have their origin upon the land, and are identical with the glaciers of the Alps and other mountain ranges. These floating masses of ice are very dangerous to navigation.

ICELAND (in Danish, "an island"), a large island in the North Atlantic, belonging to Denmark, extends from 63° 24′ to 66° 33′ N. lat., and from 13° 30′ to 24° 30′ W. lon. Its area is about 40,000 square miles. The population, formerly 100,000, became greatly reduced by epidemic disease, but in 1880 it had risen to 72,438. The south coast is almost entirely unbroken, but the northern coasts are deeply indented with fiords, which are the estuaries of the rivers that flow from the interior. The island is crossed from east to west by rugged mountains, which run nearer to the south than to the north coast, the longer rivers flowing towards the north. From these ridges numerous offsets branch out, to terminate in high and steep promontories. Between these offsets, in the vicinity of the fiords, are fine valleys, in which the inhabitants have erected their dwellings; and many of the low mountains are covered with a coarse grass, which affords summer pasture to their cattle. The best inhabited spots are on or near the banks of the fiords, where factories are built for the purpose of trade and shipping. But the majority of the inhabitants live in detached cottages or farms, a certain number of which constitute a parish, having a church and an incumbent of the episcopal Lutheran communion. The interior of the island is a dreary desert. It consists partly of snow mountains called *jökuls*, many of which are also volcanoes, and partly of vast tracts covered with lava, scoriæ, and volcanic sand. There are also several lakes, the largest of which, called Myvatn, is about 40 miles in circumference. The most extensive mass of icy mountains is that called Vatna Jökul, in the south-east part of the island. This particular jökul constituted a vast unexplored region of ice and snow into which the inhabitants in modern times had never ventured, though in earlier centuries there was a way across the northern portion of it to the extreme eastern districts. The lifeless, pathless wilderness of snow was, however, explored in 1875, when a member of the British Alpine Club, Mr. W. L. Watts, successfully made his way across it and back.

The climate is very variable—storms of extreme violence being frequent; in summer it is moist, and in winter the sky is dark and gloomy, but lighted up by brilliant displays of the aurora borealis. The south-west coasts, washed by a prolongation of the Gulf Stream, are much milder than the north, and generally free from ice. The temperature is more elevated than in any other country in the same latitude.

Forests formerly abounded, but the island is now destitute of trees, except a few stunted service-trees and birches. Although the Gulf Stream and the polar currents occasionally float drift-wood to the northern shores, the want of fuel is severely felt, and a fine white turf is used. A large portion of Iceland still remains unexplored; and its mineral resources, if we except the large quantities of sulphur, are but slightly developed. There is still room for a brisk trade in coal, borax, copper, &c., which are abundant on the island. Besides these products, the fisheries of Iceland are most prolific; and although fish and its belongings form two-thirds of the total exports, it is believed that they offer a promising field for the further employment of capital. Garden vegetables are cultivated, but no grain of any kind can be raised. The most important domestic animal is the sheep, which, with the horse, ox, pig, and dog, was introduced from Norway during the last century. It is estimated that there are about 700,000 sheep, 25,000 head of cattle, and 32,000 ponies on the island. Large numbers of the ponies have been imported into Leith, and are much used in the Black Country of Staffordshire. The polar bear is sometimes cast on the shores from the northern ice-fields. Birds are numerous; and several kinds of fish — more particularly cod—are abundant on all the coasts. The commerce chiefly consists of the exchange of wool, butter, skins, fish, and oil for European manufactures. Trade in Iceland is conducted entirely by barter, there being almost no money in circulation. The merchants supply the farmers and fishermen with foreign goods, and receive in return wool, mutton, fish, oil, &c.; but as these products are only available in their respective seasons, the merchant is obliged to give long credits, accounts, as a rule, being only made up once a year. The mass of the people, especially the fishing population, live fully up to their means in good years, and a failure of the fishing or the hay harvest, or any similar misfortune, leaves them without the means of meeting their debts to the merchants. The latter in such cases prefer to make further advances to their customers, in the hope that succeeding good seasons may enable them to pay off their debts, rather than incur the total loss which would result from withdrawing all assistance from the debtor, who would in consequence be reduced to absolute pauperism. The effect is that the majority of the people are always deep in debt to the merchants.

The only means of transport is by pack-horses, and in winter on sledges. The Icelanders are attached to their country and hospitable to strangers. There is only one advanced school, the college at Reikiavik, with a president,

eight professors, and from eighty to a hundred students; several elementary schools have been started, and domestic education is general. The people are intelligent, being universally educated to the extent of reading and writing. Reikiavik is the only town, but there are upwards of twenty trading villages, mostly on the coasts. From thirty to forty vessels sail annually from Denmark to Iceland. Formerly the trade was a government monopoly, but it is now open.

There are numerous boiling springs, such as the geysers, which throw up, at periodical intervals, columns of boiling water to the height of 200 feet; the Reykium and the sulphur springs of Krisuvik are near the south-west coast; those of Reikidal in the west district, and those of Reikiahwerf and Krabla in the north. There are also bogs of boiling mud, craters of volcanoes now quiescent, and columns of dense smoke and steam issuing from many spots. The whole island appears to be of volcanic formation, and there are still numerous volcanoes in full activity; among which are Hecla (5210 feet high), Orafa Jökul (6426 feet), and Snaefells (5965 feet). The most destructive eruptions on record were those of 1294, 1341, 1636, 1693, 1783; the eruption of Mount Hecla, 2nd September, 1845, to 6th April, 1846; and that of 1875 (Easter Monday), when one of the craters of the Jökul burst into an eruption of appalling and devastating violence.

The inhabitants are the genuine descendants of the old Scandinavians or Norsemen; they are rather a small race, with a florid complexion, flaxen hair, and an open frank countenance. The women are said to be more inclined to corpulence than the men. Scurvy and elephantiasis were formerly common, owing to the sameness and poor description of the food, and to the crowded and ill-ventilated dwellings, which are generally of the very humblest description, built of turf or pieces of lava, the crevices stuffed with moss, and the roof formed of turf. The knitting of stockings and gloves is almost the only industrial occupation.

Language.—Icelandic is the most antique of living Germanic dialects. In the great family of Indo-Germanic tongues, to which our own speech belongs, the Scandinavian

Mount Hecla.

division of the German branch consists of Danish, Swedish, Norse, and Icelandic. The latter goes back to the eleventh and twelfth centuries in its written literature, and to the sixth or seventh in its traditional songs, &c., and all this ancient literature is in style and content older than anything in German proper in any of its forms. Brief inscriptions in Runic characters on monuments, &c., still exist, of a date as early as the second or third century. Roman letters were introduced A.D. 1000, when Iceland was converted to Christianity. The value of Icelandic, because of this hoar antiquity, is simply incalculable to the comparative philologer. Many are the puzzles in English derivative which a knowledge of Icelandic readily unlocks. Take for example the verb *to be* (and it may be here remarked that the vast importance of the verb has endued it with greater tenacity of ancient forms than any other part of speech); *am*, *art*, *is*, *are*, *are*, *are*, have no relation to the modern German *bin*, *bist*, *ist*, *sind*, *sind*, *sind*, with the one exception *is* for *ist*. But with this same exception (a Teutonic importation) our English verb is closely parallel with the Icelandic. The latter runs thus—*em*, *ert* (*er*), *erum*, *eruth*, *eru*. So again the infinitive *to be*, how does this correspond with the German *seyn*, the Latin *esse*, the Greek *einai*? Icelandic helps us with *bua*, to build, that is, to cause to be, and we at once perceive the affinity with Greek *phuô*, I grow (*fuo*, if the Greeks had had an *f*), and the Latin *fui*, I was.

So stationary has Icelandic remained, in regard to its development, that while our Elizabethan writers are difficult to us and Chaucer is unreadable to many people, the Icelander of to-day finds no difficulty with his sagas of 1000 years ago. The chief method of verse employed in those old poems is ALLITERATION, which is elsewhere described in this work. The great riches of ancient Scandinavian religion and speech are contained in the EDDAS, in the "Völundar-guida" or Norse Nibelung's song

(NIBELUNGEN-LIED), far more ancient than the antique German epic of that name, and the splendid "Heimskringla," collected early in the thirteenth century by Snorro Sturleson, containing fine old sagas on the early annals of Norway, &c.

History.—Though probably discovered by the Irish in 800, the first colonists of Iceland were Norwegians, who fled in the year 874 from the dominion of Harold Harfager, tyrant of Norway. They established a republican government, appointed magistrates, and had their annual Althing, or national assembly, which was held at Thingvalla, in the south part of the island. Icelandic literature began to be cultivated immediately after the introduction of writing in 1057. Iceland fell under the yoke of Norway in 1264, and when that country became subject to Denmark in 1380 it shared its fate. It was not, however, transferred with it to Sweden in 1814, but continued under Denmark. The Icelanders are generally good sailors, and it is now indisputably proved that they not only discovered Greenland, but also America, which they called Vineland, early in the tenth century. Christianity was not established in the island till 1000. The Protestant form of worship became general about 1550. In the seventeenth century the island suffered much from the ravages of the Algerine pirates, who carried away many of the inhabitants to slavery, and its population has on several occasions been decimated by famine and disease.

In 1874, on the occasion of the millennial jubilee of the island's colonization, the King of Denmark visited Iceland, and conferred upon his subjects there a new and very liberal constitution, most of its articles being moulded upon the Danish charter of 1849, one of the freest in Europe. It conceded to Iceland, in all matters concerning the island, its own and independent legislation and administration, superintended by an assembly—the Althing—consisting of thirty-six members, thirty elected by popular suffrage and six nominated by the king. It put at the head of the country's affairs a minister named by the king and residing at Copenhagen, but responsible to the Althing, and exercising his functions through a local governor residing in Reikiavik. It also fully guaranteed the independence of the tribunals, individual freedom, liberty of faith, of the press, of public meeting, the inviolability of property, the self-government of the municipalities, and the equality of all citizens before the law. After the great calamity of 1875 very generous efforts were made for the relief of the distressed islanders, not only in Denmark, but in the city of London, where a fund was opened on their account.

Within the last century literature has been much cultivated by the Icelanders; and the language and literature of Iceland have begun to attract attention among the scholars of Denmark, Germany, and England. Three newspapers are published at Reikiavik, and Icelandic books are also printed.

Reikiavik (reek-town), the capital, contains about 2500 resident inhabitants, and is built on the south side of an inlet of the Faxe Fiord, on the south-west coast of the island. It consists of two streets, and contains the chief buildings of the island. The houses, with a few exceptions, are simply small wooden dwellings, one storey high, and coated with tar, with which white painted sash windows contrast strongly. The town has an observatory and library, is the seat of the Icelandic Society and a bishop's see. To the south-west is the peninsula of Alftaness, having a church and a number of pretty cottages. In the northern district there is a kind of town or village, called Eyafiordur, and a factory, called Husavik, on the Skialfianda Fiord, from which sulphur from the neighbouring mines is shipped. Other factories are scattered about the coast, especially in the west.

ICELAND MOSS. See CETRARIA ISLANDICA.

ICELAND SPAR is the name applied to the clear transparent variety of CALCITE. It is a pure carbonate of lime ($CaCO_3$), and cleaves in perfect rhombohedrons. It shows double refraction in a very marked degree, and as both rays in double refraction are polarized it is therefore much used in optical experiments where polarized light is required. The most usual form in which it is employed is NICOL'S PRISM. The mineral has derived its name from its being first obtained in Iceland, where the best specimens have been procured.

ICE'NI or **ECENE** (if we are to take their own spelling on their coins, were an ancient British people for ever rendered famous to us by the heroism of their queen, Boadicea. They were Gaulish in origin, invaders of some unknown time; and they held the territory just to the north of the Trinobantes (Middlesex and Essex), in the broad peninsula which fronted the North Sea and the Wash, and was cut off in every other direction by tidal marshes and the great impassable Fens—in fact, East Anglia. Their chief town was Venta Icenorum, about 3 miles from Norwich. West of them lay the midland Gauls of Britain, the Catyeuchlanians. Boadicea, in the noble verse of Tennyson, calls on these various nations for vengeance:—

"Hear, Icenian, Catyeuchlanian! hear, Coritanian, Trinobant!"

About the year 50 Southern Britain began to take the form of a Roman province, and several of the tribes, the Iceni leading them, revolted in a wild endeavour to free themselves from the fast closing toils. They were subdued by Ostorius Scapula, acting under Vespasian and Titus (the future emperors), but were kindly though firmly treated, and were permitted, upon their total submission, to retain their nominal freedom under a king whose private wealth seemed a good guarantee for peace. But a very few years saw this good government interrupted, and the tyranny of evil governors began which resulted in the grand revolt of BOADICEA, as told elsewhere.

ICH DIEN (Ger., I serve), the motto of the Prince of Wales, which was originally adopted by Edward the Black Prince, after the battle of Crecy, in proof of his obedience to his father, Edward III., and has been continued down to the present time. The motto was discovered under the plume of ostrich feathers worn in the helmet of the King of Bohemia, who was slain in the battle.

ICHNEU'MON (Herpestes) is a genus of small carnivorous mammals belonging to the family VIVERRIDÆ. The ichneumons are weasel-like in form, the body being elongated and the limbs short. The feet have five toes, and are armed with huge compressed, incurved, and slightly retractile claws. There are thirty-six or forty teeth—twelve incisors, four canines, eight molars, and twelve or sixteen premolars. The body is covered with long rigid hairs, more or less ringed with alternating shades of dark and light tints. The tail is long.

The Egyptian Ichneumon (*Herpestes ichneumon*) was celebrated by the ancients for its destructiveness among snakes and other reptiles, and many exaggerated accounts relative to its darting into the crocodile's mouth and tearing the monster's entrails were received as truth. It was one of the sacred animals of the Egyptians, and was occasionally kept tame. It is a bold and familiar animal, preying upon snakes, crocodiles' eggs, rats and mice, poultry and other birds—much resembling, in fact, a polecat in its manners. By the foreign residents in Egypt it is called "Pharaoh's rat." It is easily domesticated. In size it exceeds a common cat. The fur has a peculiar dark tawny-gray aspect, resulting from the circumstance that the individual hairs are coloured with alternating rings of chestnut-brown and yellow. The muzzle and feet have a deep reddish-brown tinge. The tail is long, thick, and bushy at the root.

The Indian Ichneumon or Mungoos (*Herpestes griseus*) is a smaller species, about 16 inches in length, of a tawny yellowish-gray colour. The mungoos is celebrated for attacking venomous serpents, and is said to have recourse to various plants as an antidote when bitten. This latter statement is now disproved, for it appears that the mungoos owes its immunity from the serpent's deadly fangs solely to its agility and adroitness in attack. Serpents are said to stand in great awe of their foe, and to invariably try to escape its attack; when evasion is impossible, the serpent strikes repeatedly at the little mammal, who dodges the blows till he sees his opportunity, "when like lightning he rushes in, and seizes the snake with his teeth by the back of the neck, close to the head, shaking him as a terrier does a rat." These tactics are repeated until the snake is killed. It also preys on rats and other small mammals, and on birds. It has been introduced into Jamaica, to free the planters from a plague of rats, with singular success.

ICHNEU'MON-FLY is the general name applied to the parasitic hymenopterous insects belonging to the section PUPIVORA. The true ichneumon-flies form the family Ichneumonidæ, but the name is often extended to the families Braconidæ and Evaniidæ. The family Ichneumonidæ is by far the most extensive; there are about 140 British genera alone, containing more than 1100 species. The wings are large and veined, the anterior pair presenting on their disc several complete cells. The body is long and narrow. The abdomen is attached to the thorax at its hinder extremity, between the hind legs, by a fine stalk or a small point; it is provided in the female with a straight ovipositor, sometimes of great length. The antennæ are thread-like or setaceous, long, and composed of a great number of joints.

Ichneumon-flies are parasitic in the larval state. By keeping down the numbers of vegetable-eating caterpillars, they confer upon man an inestimable benefit. During the summer months great numbers of ichneumon-flies may be seen exploring various plants in search of the caterpillars which are suited to rear their larvæ, each caterpillar having its own parasitical enemy or enemies. The female ichneumon, by means of her long bristle-like ovipositor, inserts her eggs into the body of the caterpillar in such a manner, and in such parts, that it does not destroy the life of the victim. In most cases these eggs are not hatched until the caterpillar has changed into a chrysalis; they then hatch, and the ichneumon larvæ feed upon the contents of the pupa case, inclose themselves in silken cocoons, and undergo their final transformations, to come forth in proper season, eating their way through the chrysalis case. Instances are not uncommon in which the eggs of the ichneumon hatch in the body of the living caterpillar, and what is most remarkable, they do not destroy its life. It is not until the larvæ have quitted their abode in the caterpillar that it dies, having the cocoons of the ichneumon larvæ attached to its skin. The caterpillar of the common white butterfly, so abundant on cabbages, affords a familiar example of this nature. At certain times of the year numbers of these caterpillars may be seen on walls adjoining gardens: on these they usually attach themselves (in some sheltered situation) to undergo the transformation into the pupal state. One of these caterpillars will appear healthy, select a convenient situation, attach itself (as usual before the change into the pupal state) by means of a silken thread around its body; but instead of undergoing the transformation, it is found after a short time covered with an immense number of small yellowish silken cocoons, spun by the larvæ of the ichneumons as they crawl from its body. These cocoons, which are about one-eighth of an inch in length, are attached to each other and to the skin of the caterpillar, which then dies.

The smaller species of ichneumons deposit their eggs in the eggs of other insects; in this case only a single egg is deposited. "Some species penetrate to the little grub within the heart of the oak-gall; others find the wild bee in its cell, the beetle in its wooden chamber hollowed within the trunk of the forest tree." In these cases the ovipositor is very long, while the species which deposit their eggs on caterpillars have generally a short ovipositor, concealed within the abdomen. The habits of the genus Ophion, a species of which, *Ophion luteus*, is common in this country, are curious. This ichneumon, which has very long antennæ, a compressed abdomen, and a very short ovipositor, deposits her eggs upon the surface of the body of caterpillars. These eggs are provided with a little stalk which has a hook at its extremity. The larva, when hatched, keeps its hinder end fixed in the two valves of the egg, and pushing its head through the skin of the caterpillar, feeds upon the substance of its host. Similar habits are attributed to species of the genus Paniscus and others. In the genus Ephialtes (a species of which is shown in fig. 7 Plate HYMENOPTERA) the ovipositor exceeds the body in length: the species of this genus are parasitic on the wood-borers (Siricidæ). The Braconidæ differ from the Ichneumonidæ by having only one recurrent nervure in the fore wing instead of two. A Japanese species of the typical genus Bracon has an ovipositor nine times the length of the body.

ICHTHYOL'OGY (Gr. *ichthus*, a fish, and *logos*, a discourse) is a department of zoology embracing the structure and natural history of fishes. The only ancient writer who has any claim to be noticed in a history of ichthyology is Aristotle. The Greek philosopher had a wonderfully correct knowledge of the general structure of fishes, and had collected much useful information as to their habits. Ichthyology after Aristotle's time was almost totally neglected till the middle of the sixteenth century, when a great advance was made by the researches of Belon, Rondelet, and Salviani. These ichthyologists, however, confounded the whales and other aquatic mammals with the true fishes, an error which Aristotle had avoided. But little was added to the knowledge of fishes till the appearance, in 1686, of the "Historica Piscium" of Ray and Willoughby. In this work fishes are clearly defined as "animals with blood, breathing by gills, provided with a single ventricle of the heart, covered with scales or naked." The English naturalists found a worthy successor in Artedi, a Swede, who has been called the father of ichthyology; in fact he established, in the words of Dr. Günther, "the method and principles which subsequently have guided every systematic ichthyologist." Linnæus, a fellow-worker and friend of Artedi, scarcely modified his classification. About this time Pennant was studying the fishes of England. Ichthyology was advanced by the labours of Bloch and Lacépède and others in the eighteenth century. An immense advance was made by the famous French naturalist Cuvier. The labours of Agassiz have already been noticed in the article GANOIDEI, a subclass the establishment of which is entirely due to him. J. Müller entered into the labours of Agassiz and extended the knowledge of fishes, especially of the Ganoids. He separated the lancelet and the lampreys from the cartilaginous fishes (Selachii), making them the types of two distinct subclasses; most modern authorities remove them altogether from the class Pisces. One of the greatest living authorities on ichthyology is Dr. Günther, to whose "Introduction on the Study of Fishes" we are mainly indebted for the preceding sketch of the history of ichthyology. The "Catalogue of Fishes," published by the trustees of the British Museum in eight volumes (London, 1859–70), brings together in one comprehensive work the results of the labours of recent ichthyologists. The geographical distribution of fishes some years ago attracted much attention; and several valuable local monographs were published, which on this point added greatly to our knowledge.

Among these may be enumerated Bennett's "Fishes of Ceylon," with exquisitely coloured plates, and Yarrell's "British Fishes," with admirable woodcuts. Nor are other labourers wanting. In the north of Europe, besides the writings of Nilsson and Eckstrom, the fishes of Denmark have been illustrated by Henrik Kroyer. The fishes of Germany have been described by Heckel and Siebold, and those of France by Blanchard. Italian ichthyology has been admirably illustrated by Charles Bonaparte, the prince of Musignano. In Asia the fishes of Japan have been described by Schlegel, of the Malayan region by Cantor, and those of India by Day. The ichthyology of Africa is represented by Rüppell, Playfair, and Günther. British North America has been the field of Sir J. Richardson's researches. De Kay's "Zoology of New York" and later publications have made us acquainted in detail with the fishes of the United States. The knowledge of the deep-sea fishes has been largely extended by the researches of the *Challenger* expedition ("Voyage of H.M.S. *Challenger:* Fishes," by A. Günther).

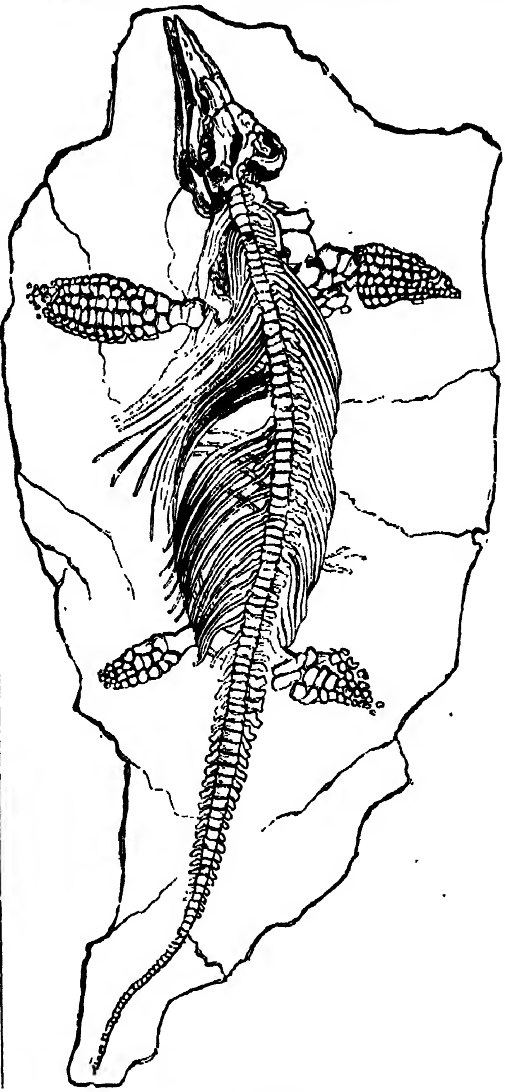
ICHTHYOPSI'DA is one of the primary divisions into which Professor Huxley divides the subkingdom Vertebrata. It contains the two classes, Fishes and Amphibia. These two classes agree in the following points:—Gills are always present at some period of the animal's life; hence the name Branchiata (gill-bearing) is applied by some to this section. The fœtal membranes, the amnion and the allantois, are absent, the latter being found in a rudimentary condition in the Amphibia; hence the names Anamnionata and Anallantoidea. The integument rarely develops any epidermic skeleton. Ribs are absent or quite rudimentary.

ICHTHYOR'NIS (Gr. *ichthus*, fish; *ornis*, bird) is the generic name of a remarkable fossil bird from the cretaceous shales of Kansas in North America. It was described by Professor Marsh in 1872. This bird was furnished with pointed teeth, fixed in separate sockets. The vertebræ were biconcave, hollow in front and behind, resembling those of fishes and the extinct bird Archæopteryx. The wings were well developed. The sternum was provided with a keel. Ichthyornis was about the size of a pigeon. Professor Marsh is of opinion that it was aquatic and carnivorous.

ICHTHYOSAU'RUS (Gr. *ichthus* and *sauros*, literally fish-lizard) is a genus of extinct marine reptiles, forming the order Ichthyopterygia, abundant in the Mesozoic or Secondary period, chiefly in the liassic and oolitic formations.

In its general outline the ichthyosaurus must have borne a rough resemblance to the modern porpoise and grampus. It had four broad feet or paddles, and terminated behind in a long powerful tail, which Professor Owen believes was placed vertically, because the vertebræ are compressed vertically, and also because it is frequently found disarticulated a short distance from its extremity, as if the weight of the upright tail had induced its fall on the commencement of the animal's decomposition. More than thirty species have been discovered, some of which must have exceeded 30 feet in length. Their principal points of difference are in the form of the head; some possessing short broad skulls, like the common crocodile, others a long slender snout, like the gavial of the Ganges.

In the head of the ichthyosaurus the most remarkable feature was the eye, which in magnitude exceeded that of any living animal, and in some specimens has been found to measure 14 inches in diameter. From the quantity of light admitted by this prodigious lens, the ichthyosaurus must have been gifted with extraordinary powers of vision. It was equally well adapted for use in air or water, and for quickly changing the focal distance when in pursuit of prey. The size of the eye seems to indicate that the ichthyosaurus sought its prey chiefly by night. On the front of the orbital cavity in which it was placed, thirteen or more petrified thin bony plates were disposed in a circle around a central aperture in which was lodged the pupil, the form and thickness of each plate closely resembling the scales of an artichoke. This circle had a telescopic effect, and enabled the ichthyosaurus to discover its prey at great or little distances. It does not occur in fishes, but is found in many birds, and the bony sclerotic of the great fish-lizard very nearly approached in form the



Ichthyosaurus intermedius.

bony circle in the eye of the golden eagle. The important advantage resulting from this curious optical apparatus was, that it strengthened the surface of the enormous eyeball, so that it might resist the pressure of the deep water to which it must frequently have been exposed. Further, it protected the all-important organ from injury by the ocean waves—to which injury an eye, sometimes larger than a man's head, must often have been subject, when the nose was brought to the surface for the necessary purpose of respiring air. The position of the nostrils, close

to the anterior angle of the eye, rendered it impossible for the ichthyosaurus to breathe without raising its eye to the surface of the water. Its immense jaws, 6 feet in length in some species, were composed of many thin plates, so disposed as to combine strength with lightness and elasticity in a greater degree than would have been effected by single bones, like those in the jaws of a mammal. An under jaw so slender and so elongated as that of the ichthyosaurus, employed in seizing and retaining the large and powerful animals which formed its prey, would have been comparatively weak and liable to frequent mishaps if composed of a single bone. Each side of the lower jaw, therefore, was made up of six separate pieces.

The teeth of the ichthyosaurus are conical, and resemble those of the crocodile, but are considerably more numerous, amounting in some individuals to 180. They vary in each species. Not inclosed in deep and separate sockets, like those of the crocodile, they bristle along one continuous furrow of the maxillary bone, where the rudiments of a separation into distinct alveoli (or cavities) may be detected in slight ridges extending between the teeth on the sides and bottom of the furrows. The contrivance by which the old teeth give place to new is analogous in the ichthyosauri to that existing in the crocodiles. In both the young tooth begins its growth at the base of the old one, where, by pressure on the side, it causes first a partial absorption of the base, and, finally, a total removal of the body of the older tooth which it is intended to replace.

The short thick neck was continued backwards into a vertebral column of more than 100 vertebræ, which are biconcave like those of fishes, securing at once great strength and mobility. The ribs were slender, most of them forked at the top, and extended along the entire length of the vertebral column, from the head to the pelvis. There was no sternum.

As the ichthyosaurus was a massive animal, it required the means of facile descent and ascent in the water. This was provided by the construction of its anterior paddles, which were half as large again as the posterior, and by the no less extraordinary combination of bones that formed the scapular arch, on which these paddles rested. This scapular arch, Professor Owen points out, resembled in the number, shape, and disposition of its bones the same parts in the curious Australian mammal, the duckbill (Ornithorhynchus). The paddles must have resembled externally the paddle of a dolphin. They are composed of a great number of bones, and deviate remarkably from the pentadactyle type, to which the extremities of the limbs of all vertebrates above fishes can be referred. The skin was probably smooth like that of a whale, and unprovided with scales. These aquatic reptiles fed upon fishes, as is proved by the mass of fish scales intermingled with coprolite throughout the entire region of the ribs, and in the more matured coprolites themselves. They also devoured other animals and even the weaker of their own species. Their prey was transmitted into a stomach which must have been nearly coextensive with the cavity of the body, and the contents were thence made to pass through an intestinal canal which resembled the spiral intestines of sharks. The coprolites or petrified fæces are found in great abundance at Lyme Regis and elsewhere. They are oblong in shape, from 2 to 4 inches in length, and from 1 to 2 inches in diameter, and are usually of an ashen-gray colour.

Ichthyosauri abound throughout the lias and oolitic formations. The chief repository has been hitherto considered to be in the lias at Lyme Regis; but they abound along the whole extent of this formation throughout England, from the coasts of Dorset, through Somerset and Leicestershire, to the coast of Yorkshire. The lias of Germany and France contains them. "The range of the genus Ichthyosaurus," says Dr. Buckland, "seems to have begun with the Muschelkalk, and to have extended through the whole of the oolitic period into the cretaceous formation. The most recent stratum in which any remains of this genus have yet been found is the chalk marl at Dover, where they have been discovered by Dr. Mantell: I have found them in the gault near Benson, Oxon." (Professor Owen, "Palæontology;" Lyell, "Principles of Geology," &c.)

ICHTHYO'SIS or **FISH-SKIN DISEASE,** the name given to a peculiar affection of the skin which causes it to greatly resemble the scales of a fish. In ichthyosis the cuticle is more abundant than natural, but it is hard and brittle, breaking up into small irregular scale-like pieces which do not readily exfoliate, but which, if removed, rapidly grow again. A defect of development, it is most frequently a congenital affection, and is often hereditary. It may be confined to a portion only of the body, or it may affect nearly the whole surface, and though it does not usually affect the general health, it is an extremely obstinate disease and often incurable.

The treatment consists in the promotion of an improved nutrition of the body, frequent washings of the skin with plenty of friction, or the use of the Turkish bath and shampooing, and the application of a mild stimulating liniment or some simple oily material to the part affected.

I'CICA, a subgenus of plants belonging to the order BURSERACEÆ. Bentham and Hooker place it under the genus Bursera, while Engler, in the series of monographs at present being issued under the superintendence of M. A. de Candolle, puts it as a section of the genus Protium. *Icica heterophylla* is a tree 50 feet in height, growing in Guiana, on the banks of the river Couron. When an incision is made in the bark of this tree a yellow balsamic aromatic fluid exudes, which retains its fluidity a long time after exposure to the air. It is called balsam of Acouchi, and is used as a vulnerary. A resin is found also in the seeds, and the natives of Guiana carry the nuts about with them on account of the scent they give out. The Caribs also use the exudation for mixing with oil, with which they anoint their bodies. *Icica heptaphylla* is a small tree, a native of the woods of Guiana. The balsam derived from this tree is called Hyawa by the natives, and is used for dysentery and coughs. *Icica altissima*, a native of Guiana, supplies the American cedar-wood, which has a fragrant odour, and is used for various articles of furniture. The tree grows to the height of 100 feet.

ICON'OCLASM (Gr. *eikôn*, image, and *klaô*, I break) is the prohibition of the use of images, statues, pictures, or other representations of sacred objects in the church. At many various times in ecclesiastical history have movements been directed to the putting down of what was called image-worship, but what should be with greater fairness called the reverence of images. No doubt the reverence of symbols by the educated and refined degenerate too often into the worship of them by the ignorant, and those who fear this danger more than they desire the religious assistance offered by the symbols become iconoclasts.

The great iconoclastic movement which the Emperor Leo the Isaurian inaugurated early in the eighth century, and which the emperors long carried on successfully in the teeth of the popes of Rome [see GREGORY II. and III.] but with the support for the most part of their own patriarchs, ended, it is true, most disastrously. The causes of this movement are obscure, and the causes of its collapse still more obscure, for most unfortunately the victors destroyed all the authentic evidence. Whether Leo hated fine art as such, or whether he feared that reverence might degenerate into superstition, we know not; but this is certain that the attempt to change the religious forms of the world of Christendom originated purely at court. Probably in this we may look for the cause of its failure. Iconoclasm removed certain aids to faith without supplying others; it discarded the aid of the sense of beauty without giving any new fervour to reclothe the naked walls of the

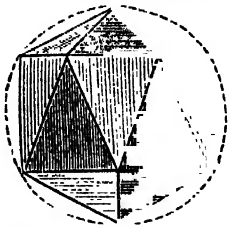
soul. Puritanism, in our own country, nearly 1000 years later, substituted what was to many a higher form of religion for what was to them a lower, and accordingly it endured, and yet endures; but this iconoclasm of the eighth and following centuries was a mere negation, a fanatical destruction of sacred objects at the arbitrary command of the emperors, and negation, we know, supplies no bond, nor can it ever supply one. The results, as the power of the emperors grew weaker, were momentous. The West sprang asunder from the East, the popes owed their splendid religious pre-eminence almost entirely to the failure of this great ecclesiastical tyranny. But the severance went further, and a political disruption took place; first Italy split off, then the great Frank rulers were appealed to for aid, and finally the HOLY ROMAN EMPIRE (or the Empire of the West or of Germany) was founded, and Charles the Great was crowned as its first sovereign at Rome in 800 by Pope Leo III. The main events in a movement which thus shook the ancient world to its foundations have now to be recounted.

Breakings of images here and there began to occur about the year 700. In 717 Leo, an Isaurian, was raised to the throne for his real merit. This we can see even through the malicious accounts of his enemies, through whom alone he is known to us. He soon showed himself a stern converter of Jews and heretics by force, and in 726 he issued the famous edict which started the governmental persecution of the worshippers of images. This edict did not command the destruction of images; it only prohibited the worship of any statue or picture of Christ, of the Virgin, or of the saints. Apparently this is not the first edict, though it is the first we possess, for it orders pictures, &c., to be raised higher on the walls that the faithful may not kiss them, as if carrying out more fully a prohibitory course already begun. An alarming volcanic eruption in the Ægean was claimed by the emperor as indicating the wrath of God against his subjects, who had rebelled on all sides against the edict (issued as a mere proclamation without church council or assent), and by the monks it was claimed as a warning against the emperor. A second edict quickly followed, now ordering the pictures and statues, which the people insisted upon continuing to revere, to be mutilated or utterly destroyed. Men saw with horror soldiers hacking out the costly mosaics, whitewashing the priceless frescos, throwing down and dashing to pieces the splendid statues, many of them the work of antiquity turned to Christian uses. When we consider that these images were nearly all held to have wonderful powers to heal or to protect, we can realize the cry that went up on all sides. St. Gregory II., the pope, seized his opportunity. His famous letter of 729 raised the standard of revolt. Gregory went to an extreme on the other side, which later days certainly would not endorse. Speaking of the well-known statue of St. Peter (as it is called), which yet stands in St. Peter's at Rome, he dares Leo to attempt its destruction, "for," says he, "the statue of St. Peter, which all the kingdoms of the West *esteem as a god upon earth*, the whole West would take a terrible revenge." The aged Germanus, patriarch of Constantinople, withstood the emperor with all the authority of his ninety-five years: he was removed from his see in 730. John of Damascus, in three orations of real power, now took up the opposition in the East, and laid the foundations of the orthodox side of the feud. Pope Gregory III., on his accession in 731, sent an envoy charged to terminate the schism: he was seized and thrown into prison. On this a council of the West was held at Rome, a second envoy was sent with like fate, and a third envoy succeeded only by stratagem in delivering a letter to the emperor. Leo at his death in 741 was succeeded by Constantine Kopronymos ("the defiled," as he was named in hatred). Constantine only gained his throne by a battle of fearful ferocity against a relative who, under promises of restoring the images, had seized on the supreme power when Leo died. The usurper and most of his adherents were blinded and turned to public sport in the circus; the patriarch was blinded, set upon an ass with his face to the tail, and so sent through the city, till in his misery he recanted and became iconoclast, when he was restored to his dignity. In 754 was held the great synod called the Third Council of Constantinople (the seventh Œcumenical Council), and when we consider that 348 bishops assembled there it must be allowed great weight. The pope and three of the four patriarchs were absent, only he of Constantinople (now held the least important) was present. This council unanimously decreed the destruction of all images, but the careful preservation of crosses. (The crucifix was not yet known for a century and a half or more.) Against this Pope Stephen IV. held the second Lateran Council in 769. In 775 Leo IV. succeeded his father Constantine Kopronymos, and although he continued the iconoclastic policy, his gentler character relaxed the former rigour. His wife, the Empress Irene, was in secret an image-worshipper; and as soon as Leo died (not without suspicion of poison), in 780, she seized the throne as regent for her son, the infant Constantine, and almost at once restored the worship of images (784). Pope Adrian I. styled her and her son "a new St. Helena and a new Constantine." The second Council of Nicæa or Nice (Nikaia in Asia Minor) was held in 787, and formally anathematized iconoclasm, restoring the use of images in the church, now not by tradition merely and usage, but as a dogma of the church. "We who adore the Trinity worship images; whoever does not the like, anathema upon him! Anathema upon Theodorus, falsely called Bishop of Ephesus; against, &c.! Everlasting glory to the orthodox Germanus, to John of Damascus, to Gregory of Rome," &c.! But when Constantine grew up and evidently was preparing a new onslaught upon images, his mother executed that appalling crime which has blasted her memory for ever: she seized her son and had his eyes torn out with circumstances of unusual horror (787). It seems incredible that a mother should thus act even under the fierce impulses of ambition and fanaticism. Irene reigned five years—the first woman who had by name held sway in the empire of the world. Seizing this pretext the pope crowned the great Frank king, Charles, as the lawful (male) successor of Constantine, who had died of his wounds, and the Holy Roman Empire claimed now (800) to be the true empire of the world. See HOLY ROMAN EMPIRE.

The West was thus politically and spiritually perfectly separated from the East, and the ruin effected by iconoclasm was complete. But its course was not quite run. Under Nikephoros and Michael Rhangabes, who succeeded Irene, nothing was done, but Leo the Armenian, the Emperor Leo V. who deposed Michael in 813, once again raised the standard of iconoclasm. He was murdered on Christmas Day, as he stood singing at the altar, by fanatics of orthodox views (821). Michael the Stammerer, who seized the throne upon this, held a rough impartiality as to iconoclasm; but his son Theophilus, who reigned at first with his father, became the fiercest iconoclast of all the emperors when he came to reign alone in 821. Even the sacramental vessels, if they bore any image or figure, were melted down by his orders. Every previous rigour was outdone. Walls formerly covered with sacred subjects were not only whitewashed, but were painted afresh, for their more complete desanctification, with birds and beasts. Again images were restored by a woman; this time by the Empress Theodora, who upon her husband's death, in 842, became regent for her infant son Michael, afterwards Michael the Drunkard. This time the restoration was permanent, but it did not take the form of encouraging statuary so much as splendid mosaics. The long contest had filled many minds in the East with a feeling of danger lest a statue might become an idol. Accordingly the usage

of the Greek Church at the present day allows pictures, whether frescos or mosaics, but rejects statues and engraved figures. See IMAGE WORSHIP.

ICOSAHE'DRON (Gr. *eikosi*, twenty, and *hedra*, a side or base), a solid geometrical figure of twenty sides.



Regular Icosahedron.

A regular icosahedron will have all its faces isosceles triangles. The icosahedron is bounded by twenty equal faces, has thirty edges, and twelve solid angles, each of the latter being formed by the meeting of five plane angles.

I'DAHO, a territory of the United States, is bounded on the N. by British Columbia, on the E. by Montana and Dakota, on the S. by Nevada and Utah, and on the W. by Oregon and Washington Territory. Its greatest length is about 480 miles from north to south, and its greatest breadth is about 340 miles. The area is estimated at about 90,000 square miles. It was organized as a territory on the 3rd March, 1863, since which its limits have been reduced by the formation of the Montana Territory. According to some writers the word *Idaho* signifies "gem of the mountains." The surface is generally mountainous. The Rocky Mountain range extends along the eastern and north-eastern border for a distance of about 250 miles. Fremont's Peak, which is the highest peak of this range in the United States, having an altitude of 13,570 feet, is on the boundary between Idaho and Dakota. Minor ridges occur in different parts of the territory, and the scenery is in many places very grand and impressive. The mountainous parts are well wooded, and the soil of the valleys and lowlands is fertile. The principal rivers are Clarke's River, the Lewis or Snake, Salmon, Clearwater, Boisee, Green, Palouse, Malade, Payette, and Lapwai rivers.

Gold and silver are found in large quantities in Idaho, especially in the vicinity of the Salmon, Boisee, and Clearwater rivers, and mining operations are in active progress. Limestone is found on the Clearwater River and other places, and valuable gray sandstone in the mountains. The climate is cold and stormy in winter, and dry and arid in the summer and autumn. The census of 1860 furnished no information respecting this territory, which at that time contained few inhabitants except Indians. The chief towns are Idaho City, Lewiston, Placerville, Boisee City, and Pioneer City. The seat of government has recently been removed from Lewiston to Boisee City. In 1880 the population of the entire territory was 32,946, chiefly miners.

IDE (*Lenciscus idus*) is a fish of the carp family (Cyprinidæ), belonging to the same genus as the roach, dace, chub, minnow, &c. It is a native of the fresh waters of Central and North Europe, and is also found in the brackish waters of the Baltic. It is not found in England. In some parts of Germany it is domesticated, in which circumstance it undergoes a state of incipient albinism, changing in colour from bluish-gray to orange; it is then known as the Orfe.

IDEA is a term of philosophy and of psychology which has now happily attained a perfectly well-defined meaning. An idea is the representation and reproduction in the mind of a sensation or emotion after the original stimulus of the feeling has been withdrawn. Or it is a result of the constructive power of the imagination working upon the materials of memory, and building up in this manner what may be fairly called *ideas of ideas*.

A remarkable fact about some classes of ideas is their tendency to become realities. Everyone of mature life must have noticed the terrible manner in which a notorious crime, for example a cruel murder or a ghastly suicide, is imitated by persons of susceptible minds, sometimes in several instances, so as to form a sort of epidemic of crime. It is within everyone's experience also that excitable persons may be made ill, or at all events, if ill, may be made worse, simply by being told that they look very ill. Another equally astonishing thing is the fascination of a precipice: the fearful dread of falling so fills the mind as to throw the will almost into the track of urging a mad leap out into space. It frequently requires a very firm hold on one's mind, as all travellers will admit, to overcome this extraordinary tendency. It is this power of an idea which lies at the root of sympathy; we regard the sorrows of others till they possess our mind as if they were our sorrows, and we hasten to alleviate them with as much eagerness as if they were our own.

Ideas of memory, ideas of actual feelings or of imagination, ideas built up out of memories of actual feelings, have no essential difference between their nature. But it is evident that from our ideas of a large number of separate things we can abstract certain qualities which they have in common, and thus we can evolve quite another class of ideas, namely, those which are called *abstract ideas*, which, though not absolutely true to any one instance, are partially true in a large number of instances. Sweetness carries a definite meaning after we have examined a great many sweet things and recognized their similarity in this respect; but sugar is not merely sweetness, it has a variety of other attributes as well. To call sugar sweet is but very imperfectly to define it. Nor does the sweetness of sugar exhaust the contents of our notion of abstract sweetness. This view of abstract ideas is called *nominalism*, and represents one side of a controversy of very ancient date. Pythagoras, Anaximander, Anaxagoras all gave absolute *realism* (as it has since been called) to abstract ideas, as those of number and others; and it came almost to be true that anything which had a name must also, in Greek eyes, have a *real* existence. This has lasted down to our own day, though much enfeebled; for we of to-day are tainted with the old taint where we least expect it, as we may see from the first example to hand. Everything has a certain extension, and comparing this quality in many things we arrive at the notion of space—a purely abstract idea. But do we not all speak of space and think of it as a real existence?

The word *idea* has also had other meanings, the principal varieties being the peculiarly wide meanings given to the term by Locke and Kant, and the peculiarly narrow one used by Plato.

According to Locke, "Ideas are whatever is the object of the understanding, whatever a man thinks, or whatever it is the mind can be employed about thinking." In this large sense the word is generally employed by English and French writers, and also by the Germans before the time of Kant, who ascribes to idea a higher but limited signification. According to Kant idea designated every conception formed by the reason (as distinct from the understanding), and raised above all sensuous perception. These ideas he subdivides into (1) empirical, which have an element drawn from experience—for instance, organization, a state, a church; and (2) pure, which are totally free from all that is sensible or empirical, such as liberty, immortality, holiness, felicity, deity. Another division of the Kantian ideas is into theoretical and practical, according to a similar division of the reason itself. Thus the idea of truth is a theoretical idea, that of morality a practical idea.

According to Plato, however, idea meant nothing of all this. Plato conceived a whole world of ideas, as he called them. Before birth our souls, he says, live among the absolute, the absolutely beautiful, the absolutely true, the absolutely just, &c. Then in this world we see partly beautiful things, partly true, partly just, and we *remember* those antenatal perceptions of ours, and so recognize what on earth we call beautiful things, true thoughts, just actions, &c. These partake in a partial imperfect way of those great perfect universals to know which is the only real knowledge, and which indeed are the only realities which remain steadfast among the shifting phenomena of life. Such is the Platonic doctrine of ideas. And who is not conscious of that mysterious sense of having seen a thing before which all evidence shows is seen for the first time? It is an experience not limited to sight nor to any sense, but extending to thought, and indeed to every part of the mind. All thinking men have seasons when they seem living a life for the second time, and they cry with Wordsworth—

> "Our birth is but a sleep and a forgetting;
> The soul that rises with us, our life's star,
> Hath had elsewhere its setting,
> And cometh from afar."

At the same time the greatest of ancient philosophers, Aristotle, saw the vast assumptions of Plato to be unwarrantable, and he stoutly maintained that general ideas (as of sweetness, of beauty, of justice, &c.) had no existence separate and apart from their particulars (as sweet things, beautiful forms, just actions, &c.); in fact, he founded nominalism, or, to be more accurate, conceptualism.

Innate Ideas.—A fierce controversy has divided philosophers from the earliest times as to the origin of knowledge. Those who side with Plato would of course hold that the mind has truths implanted in it beyond experience, while those following Aristotle would develop into a party resting all knowledge upon the facts of experience. As finally elaborated by Leibnitz, the doctrine of innate ideas teaches not so much that the actual notions of space, time, cause, number and form (as in mathematical axioms, &c.), right and wrong, God, immortality, &c., to which the theory mainly refers, are as such already in the mind at birth, but rather that the capacities for them are there. So might we say of a great painter that he had as an infant the capacity to become an artist, and this capacity by study and hard work he had developed. Yet no study and no work could have given him the genius, although it gave him the skill necessary to bring forward that genius. Leibnitz distinguishes between *idées innées* and *idées connées* quite clearly.

Opposing this we have Locke with the old Stoical conception of the mind as a sheet of blank paper, upon which experience writes the message of the world.

We can now see that both were right and both wrong. For while on the one hand we can explain, with our greater psychological knowledge, what was insoluble to Leibnitz, tracing so much of our ideas of time and space, &c., to postnatal experience as to warrant us in thinking that our successors will quite solve the problem, yet on the other hand we now have the evolution hypothesis, which, by its allied doctrine of HEREDITY, effectually throws over Locke's blank-paper theory. The child of an educated man has a brain of far different texture to that of a savage. Do we not find some races enduring slavery peaceably, while the torch of liberty is never suffered to go out in others? Clearly we inherit tendencies, as we inherit features, from our parents. But to inherit ideas is quite another matter, and it is almost beating the air in our day seriously to attack a doctrine so effete as that of innate ideas. The chief arguments against this doctrine had better be briefly given, however, for purposes of reference. (1) Most of our knowledge is admittedly gained by experience. Why make a distinction for this select class of general ideas? (2) Every generation extends our knowledge of psychology; it seems wrong, therefore, to say of certain ideas (as space, time, &c.) that they are impossible to account for from experience, since further discoveries may so account for them. (3) Those who hold that general ideas have no existence apart from particulars would be landed in the absurdity of postulating a large number of "innate particular ideas." For instance, if the idea of space be but abstracted from things occupying space, then for us to have an innate idea of space we must have a considerable number of ideas of things which occupy space. Perhaps one of the greatest stumbling-blocks of those who hold the theory of innate ideas is the fact of causation, which they say contains a causative nexus beyond all experience. Whenever the sun shines it is warm, and this they say is not a mere consequence or succession of states, but is a necessary consequence. The warmth is caused by the sun: it does not merely follow upon the sun's shining. This is felt as an intuition (another name for an innate idea); since the mere statement of the fact cannot show anything more than two phenomena, one of which preceded the other. Yet reasoning upon that we declare that everything must have a cause. But the experience-philosophers reply that it is not at all necessary to say this. Put it in the form that "every event may be preceded by another event," and a quite different "cause" or "effect" is not unthinkable; that is to say, there is no special and invariable causal nexus. Take the special instance given above. It is perfectly easy to think of the sun shining without giving warmth, or to think of warmth from other causes than the sun. The boasted necessity is found not to exist on trial. We simply know that whenever the sun has shone warmth has followed, and we find it safe to act upon this. There is no need to go further and say it must follow, and we have no right to do so. See also the remarks upon causation in the section on Hume's philosophy in the article HUME.

IDEAL. An ideal, whether of a material object or of a mental concept, results from the sublimation or purification of many perceptions or conceptions, rejecting their faults or shortcomings and preserving only their perfection or approaches towards perfection in their several kinds. In fact, what we now use the word ideal for is represented in great part by the Platonic *idea*. [See IDEA.] But while we use the term ideal in this sense, so that our "ideal of beauty" or our "ideal of truth" is truly the Platonic "self-beautiful" or "beautiful-idea" and "self-true" or "truth-idea," we have also another and very important sense for it, which perhaps shows clearest in the world of art. Ruskin ("Modern Painters," ii. 13) says, on this meaning of the word, "Any work of art which represents not a material object, but the mental conception of a material object, is in the primary sense of the word ideal; that is to say, it represents an idea, not a thing. Any work of art which represents or realizes a material object is in the primary sense of the word unideal." So also said the artist Guido—"The beautiful and pure ideal must be in the mind, and then it is no matter what the model is." A photographer gives a truer portrait, line for line, than an artist, it may be; yet the element of the ideal is wanting. The skilled portrait painter, even by the way his colour is dashed on to the canvas or carefully and smoothly laid, or by his use of the harshness of bright light and dark shadow here and the gentlest half-tones there, will indicate the character of the living man or woman before him. In fact, he works with an ideal before him.

So with higher work than even the noblest art. No one who attempts life without an ideal can make other than a sorry failure of it. To realize ever so little a part of the pure ideals of youth is the highest pleasure that can fall

to man, and blessed is he who can escape the frosts of disillusion and keep his ideal untarnished and undegraded to the end. But, on the other hand, to regard the great ideals of conduct as things afar off and inaccessible is to make a serious mistake. Ideals are formed, if they are anything more than fairy tales of the imagination, if they are to elevate our conduct and not enervate us to the worthless condition of day-dreamers, out of the actual. Thus says the great prophet of our time, "The situation that has not its duty, its ideal, was never yet occupied by man. Yes, here, in this poor miserable hampered despicable Actual, wherein thou even now standest, here or nowhere is thy Ideal; work it out therefrom, and working believe, live, free. Fool! The Ideal is in thyself, the thing thou seekest is already with thee." (Carlyle, "Sartor Resartus," ii. 9.)

IDEALISM is a theory of the visible world propounded by Bishop Berkeley in his "Principles of Human Knowledge." Berkeley uses the word idea (surely one of the worst treated words in the language) in a somewhat peculiar sense. Ideas, he says, are of three kinds—(1) ideas or forms of sensible objects, *i.e.* perceptions; (2) ideas of mental origin (passion, emotions, &c.); and (3) ideas of memory, or mental reproductions of ideas of sensible objects. Everyone would at once admit that the two last have no existence apart from the mind, and Berkeley's contention was that the first class also come into this definition. A certain colour, taste, smell, figure, &c., constitute an idea of an apple. Ordinary men would say these are our sensations from something whose real nature we know not, nor do we know how it appears to senses other than human, but that it is a something we do know. This is called Materialism. Berkeley denies the existence of this something unless there is a mind to perceive it. He considers it as being as purely bound up with the existence of the mind as is an idea of memory or an idea of emotion. But he adds the important qualification that substances can only exist when they are perceived by a mind, whether a created mind or an eternal spirit. If there be substances which can exist without mind, argues he, it is impossible we should ever know them; and if those substances which we see and feel have no existence apart from our mind, they are none the less true while we perceive them. Of course it is easy to kick against a stone, and by thus proving its materiality to fancy one has conquered the philosopher—

"And coxcombs vanquish Berkeley with a grin."

But the dilemma stated above remains for all thinking men, and has never been removed. It is absurd to state that Berkeley argues against the reality of nature. He admits at once the superior stability of ideas of external objects to the purely subjective ideas (his second and third classes), and this being so, he calls on us to justify the assumption of some unknown matter forming a substratum for such ideas.

Berkeley's idealism was vigorously but somewhat crudely opposed by Reid's coarse "Common-sense Philosophy"—thorough-going contented materialism. John Stuart Mill has the credit of harmonizing the two schools. He defines our idea of a material thing as of something which exists apart from ourselves, and which exists therefore when we are not thinking of it. We can further believe that things exist which we have never seen and shall never see. This he explains from the laws of association of the mind. I see a piece of white paper on a table. I go into another room and I am persuaded it is still there. I believe that if I place myself under the same circumstances at any moment I shall see it again. That is to say, I recognize a possible sensation. These possibilities are what we call the external world, they are the most permanent ideas we have. We call them matter, the external world, and other names; although, when we push it home, such a phrase is found to mean no more than a group of sensations. Matter is, as Berkeley said, a mental fact, non-existent without a percipient mind; but it is also the fact that it is recognizable by all minds, or by our own mind at any given time under the special circumstances required. We therefore naturally come to regard it as something outside ourselves and all other minds, though matter is but the great permanent possibility after all.

IDEN'TITY signifies sameness. In this sense it is employed in the phrase personal identity, where it signifies the invariable sameness of the thinking subject or the I. In a secondary sense it denotes a merely relative identity, which may also be called logical or abstract. Thus, in logic, whatever things are subjects of the same attribute or collection of attributes are considered the same; *e.g.* dog and lion are the same relatively to the common notion quadruped under which they are both contained. Again, in physics, a tree may be asserted to be the same in relation to all the rights of property, notwithstanding the physical change it undergoes from the constant segregation of old and aggregation of new particles. Lastly, it is only in this logical use of the term that we can be said in memory to be conscious of the identity of the reproduced and the original idea; for if they were absolutely identical it would be impossible to distinguish between the first appearance and the recurrence of an idea.

According to Butler it is impossible to define the idea of personal identity, but it is easily ascertained; for a comparison of one's self in any two moments of existence suggests immediately the idea. and at the same time the identity, of ourselves. It is only by the growth of the memory that we develop the consciousness of personal identity, of a permanent self existing through and outlasting all the changes of life; and the same remark in a less degree applies to the identity of objects.

IDES, a division of the Roman month which perhaps might pass unnoticed here, as a piece of pure antiquarianism, were it not for a line in Shakspeare, the opening line in the third act of "Julius Cæsar" (who had been bidden by a soothsayer to "beware the ides of March"). Seeing the soothsayer, he laughingly says to him, "The ides of March are come;" the man replies, "Ay, Cæsar, but not gone"—and a few minutes after the great Roman meets his death.

The ides were intended to divide the months in half, as nearly as might be, but as the length of the Roman month varied the ides varied. The nones were on the 5th or 7th of the month, or as the old doggerel has it—

"In March, July, October, May,
The nones fall on the seventh day,"

and in these months the ides, always eight days later than the nones, therefore fell on the 15th. In all other months the nones fell on the 5th and the ides on the 13th. Cæsar's fatal day was thus the 15th of March. The Romans did not reckon by the first, second, third day, &c., of the month, but so many days before the nones, before the ides, before the calends (the first) of the next month. Thus the 12th of March would be a. d. iv. id. Mar. (ante diem quartum idus Martias), the fourth day before the March ides. We should now say the third day before, but the Romans always counted inclusively.

ID'IOM (from the Greek *idios*, peculiar to oneself) is the grammatical term for a mode of expression peculiar to a language. Thus the English idiom "It is I" corresponds to the French idiom "It is me" (*c'est moi*).

IDIOSYN'CRASY literally means a peculiar temper or disposition, and is the name given to any constitutional peculiarity, whether physical or mental. Uncommon partialities or dislikes, unlooked for effects produced on persons by ordinary causes, and unusual conditions of body or mind, are usually termed idiosyncrasies.

IDIOT. A person devoid of mental power is to be sharply distinguished from one in whom the mental powers are diverted from their use. The first has the apathy of the brute, the second may suffer from but too keen and sensitive a humanity. The first we call an idiot, the second a lunatic. No use, above the very simplest, is to be made of an idiot, but our lunatics are among our greatest benefactors when the lunacy is not permanent. The great philosophers Newton, Kant, and Comte, the wits Swift and Lamb, the poet Cowper, the musical composer Schumann, the artist Blake, and many others, each of the highest rank in his vocation, prove the truth of Dryden's line—

"Sure great wits near to madness are allied."

The derivation of the word idiot is very remarkable. The Greek word *idiôtês* means a private person, one who has held no state office; and such expressions as "priests and idiots" for priests and laymen, or "poets and idiots" for inspired and uninspired writers, are not uncommon. But from an idiocy of choice to an idiocy of necessity was an easy step; and it came to be felt that if a man remained all his life without fulfilling any public duty, it was for want of wits. Therefore idiot became synonymous with lack-brain. But the Greek original usage crops up here and there in our older writers, and Jeremy Taylor speaks of "humility being a duty in great ones as well as in idiots," meaning by the latter private persons in the state.

Idiocy is further distinguishable as mental deficiency occurring during infancy or the early periods of life. In its most extreme form it was defined by M. Séguin as a condition in which the person affected knows nothing, can do nothing, and cannot even desire to do anything; and though it might seem impossible to find such a being as this fashioned externally as man, yet creatures have been born who have continued to live although blind, deaf, dumb, incapable of voluntary movement, and apparently destitute of feeling. From this, the lowest kind of idiocy, numerous gradations upward may be distinguished, until some are reached who stand very near the level of hundreds who pass in society for feeble-minded persons, but still for responsible free agents.

Diminutive stature is usually regarded as, in most cases, a symbol of idiocy, but no dimensions of the head, except in the extremest diminutiveness, or other measurements often relied upon, can be regarded as true criteria of imbecility. It is very curious, however, that the result of the examination of more than 200 cases showed that in an immense number the sides of the face were unequal, in many the palates were inordinately arched, and in some the two sides were unsymmetrical; in others the palate was excessively flattened, while in some it was prominently keeled, and in a few the palate bones did not meet. Their dentition also was found to be peculiar and the tongue in an abnormal condition—the size being sometimes larger than common, and occasionally inordinate. That therefore so many are mute, or semi-mute, or indistinct in utterance, is no wonder. These corporeal defects are attended by uncleanly habits, gluttony, peculiar unhealthy looks, an awkward and irregular gait, an involuntary flow of saliva, and automatic motions of the head, limbs, tongue, and lips; while the ear heeds not the instruction it receives, and the eye sees the light, but makes no definite distinction of form, colour, or size. Yet nothing further can be safely stated as a generalization than that, as a rule, the perceptive powers are defective, the fancy frivolous, and the whole bearing more or less eccentric. Some are vociferous, grinning, and facetious; others mutter, mope, and sulk, and are very vicious. Again, many are mild, affectionate, and tractable, while others are violent, depraved, filthy, and repulsive.

Causes of Idiocy.—The majority of cases of idiocy are congenital, and the arrestment of the evolution of intelligence may be induced by a variety of causes. Where the parents suffer from struma, tuberculosis, alcoholism, or constitutional debility, induced by over-strain of the mental powers, over sexual indulgence, &c., the idiocy of the offspring may be a result. Where a constitutional taint or tendency to mental disease runs in a family the intermarriage of near relations may have a similar result, or it may arise from fright, anxiety, or disease on the part of the mother previous to the birth of the child. Other causes are injuries received at birth, bad nursing and defective nutrition during infancy, and where it occurs later in life it may be a consequence of some accident causing an injury to the skull, sunstroke, or from one of the many different forms of brain disease.

Institutions for Idiots.—It is only during the present century that any efforts on a large scale have been made for the amelioration of the condition of idiots, and at the present day the number of asylums established is by no means equal to the national requirements of society. Desultory efforts were first made in Paris, Berlin, Switzerland, &c.; but little permanent good was effected till the year 1846, when an asylum was set up by the authorities of Massachusetts, which example was quickly followed in Pennsylvania, New Jersey, and New York. Great Britain also at this time became alive to the necessity of special provision for the idiot.

A small establishment was opened at Highgate in 1847 as an asylum for idiots, and the advantages of such institutions quickly became manifest. In 1855 the National Asylum at Earlswood, Surrey, was opened by the Prince Consort, and the experience gained in this magnificent institution has been of the highest value in the treatment of such as are idiotic.

The Earlswood Asylum was incorporated by royal charter in 1862, and the average number of inmates now amounts to about 600. The system combines bodily exercise and drill with instruction in schools, and is very successful. The asylum is open to idiotic and imbecile persons from all parts of the United Kingdom; but the inmates are divided into three classes—those who are elected on the charity, and who pay nothing; those whose friends can partly pay their cost, and who are admitted at a commuted rate fixed by the board of management; and those who are the children of prosperous parents, who are able and willing to pay the full sum charged.

The success of Earlswood Asylum has directed the attention of philanthropists to the special claims of the idiot, and has tended to the initiation of several institutions in various parts of the country, the chief being the Royal Albert Asylum at Lancaster, opened in 1871. It is built on the plan of the Earlswood institution, and is designed to receive 500 inmates. In Scotland there are the asylums of Baldoran, Forfarshire, and the larger institution at Larbert, near Falkirk, which are zealously aided both in the capital and at Glasgow. There are also some idiot asylums on the Continent and in America—the best of the latter being one supported by the state of New York.

The 25 & 26 Vict. c. 43 enables the guardians of a union to contract with the managers of any institution, supported wholly or in part by voluntary contributions, for the education of idiotic persons, and to pay for their maintenance a sum not exceeding the cost of their relief in the workhouse.

Education and Occupations of Idiots.—The possibility of teaching an idiot to read, write, and cast accounts depends much on taking advantage of personal peculiarities, and a perseverance which knows of no limit to its repetitions of the same thing till the conquest is achieved. The first step is to eradicate bad habits, and as soon as possible to engage the pupils in some occupation, rewarding their efforts with praise and encouragement. These employments are of the simplest kind, as the unravelling of

cocoa-fibre for mats, splitting rods for baskets, and preparing horse-hair for mattresses. Besides these gentle inducements to daily work, the improvement of the bodily condition is a matter of hourly and daily care. It would be wearisome to enumerate the school methods in the various institutions. All that can be said is that they are furnished with the most ingenious appliances, and something new is being continually added. Some subjects are taught to a large number collectively. The multiplication tables are sung, accompanied by various movements of the arms and legs. Reading, writing, arithmetic, drawing, and in the lower classes letters and figures, counting, imitation, speaking, weighing, telling the time, colours, and other simple things, are taught to less numbers together. As the pupils advance, of course the teaching advances also; to writing from dictation, to reading in classes, to object-lessons, and to instruction in writing, arithmetic, and drawing.

Nothing is more remarkable than the cheerful aspect of the schools, workshops, and other portions of the establishment at Earlswood, where these various employments are carried on. The learners enter into their work with surprising pleasure; and it is a curious fact that they frequently perform examples in the rules of arithmetic quickly and accurately, without knowing their names properly or their meaning.

In the girls' school efforts have been successfully made to introduce domestic work as a part of the lessons. Bed-making, scrubbing, and the processes of household economy are systematically taught, and afford agreeable diversion from the more strictly scholastic labour.

The amusements in summer and winter are carried out with much spirit. The monthly winter concerts are sources of great pleasure. The love of music is almost universal among the inmates, and the efforts of the staff in this direction have been amply rewarded by the delight which they have been able to inspire.

Nearly all the inmates who are considered competent to undertake it are encouraged to follow some industrial occupation—such as shoemaking, tailoring, carpentering, mat-weaving, and farming—and the interest which they manifest, and the skill which they exhibit in it, are often surprising.

The total number of persons returned as idiots or imbeciles in England and Wales at the census of 1881 was 32,717, being in the proportion of one such person in every 794 of the population. The proportion in 1871 was one in 771, so that as regards this kind of mental unsoundness a diminution had apparently occurred in the course of the decade. As there is no reason to suppose that the returns made in 1881 as regards this kind of insanity were less truthful than those made on the previous occasion, it is fair to conclude that the apparent was also a real diminution. In Ireland, on the contrary, the census returns appear to show a decided increase in idiocy. The number returned as idiots in 1881 was 8639, or one to every 598 of the population, whereas in 1851 there was, according to the returns, only one in every 1336, and in 1871 only one in every 802. In Scotland the number in 1881 was 5991, or one to every 623 inhabitants.

I'DOCRASE (Gr. *eidos*, like; *crasis*, a mixture), also called *Vesuvianite*, from its occurrence there, is a complex silicate of lime and alumina that occurs in some lavas, especially those of Mount Vesuvius, and in blocks of crystalline limestone ejected from the crater. It occurs in prismatic forms, has a hardness of 6·5, and specific gravity of 3·4. It is of a brown, green, or yellowish colour, with indistinct cleavage.

IDOL'ATRY (Gr. *eidolon*, an image; *latreia*, worship). An idol is an image worshipped as a god, and the act of worshipping such an object is called idolatry. In its fullest meaning the term includes FETICHISM; *animal worship*, in which certain animals are adored as symbols of divine powers; *star worship* or *astrolatry*, which at first addressed itself to the heavenly bodies themselves, afterwards to their symbol, fire, and ultimately to certain idolatrous representations, such as Baal, Moloch, Adonis, &c.; *ancestor worship*, which afterwards developed into hero worship and the adoration of the gods represented in the human form, or *anthropolatry*. The little that is known of ancient history is sufficient to show that in the past idolatry has been inseparably connected with the religion of nearly the whole of the human race, while at the present day it is practised by two-thirds at least of the inhabitants of the world.

The Hebrews, who, during the latest period of their history as a nation and subsequently, have been distinguished for their spiritual monotheistic belief and their intense hatred of idolatry, were yet almost wholly given to polytheism and image worship up to the period at least of the Babylonian captivity. The historical books of the Old Testament, from Joshua to Ezra, are full of references to the idolatrous worship that was combined by the majority of the people with that of Jehovah, until sometimes the worship of the latter was confined to a faithful few who observed it in secret (1 Kings xix. 10–18). From these references, and the allusions found in the books of the prophets, it appears that nearly every form of idolatry was known and practised by Israel. From the Phœnicians, and perhaps from the Egyptians, they learned the worship of the heavenly bodies (2 Kings xxiii. 11; Amos v. 26, &c.); animal worship, as displayed in the adoration of the golden calves set up by Jeroboam and the brazen serpent destroyed by Hezekiah, was common throughout the whole of their early history, while in the sacred trees and groves with which the land was filled, we see evidence that they practised the gross Phallic worship common among the Phœnicians. Even the horrible practice of offering human sacrifice was not unknown among them, and we find it referred to as late as the time of the prophet Jeremiah (Jer. vii. 31). Idolatry was not wholly given up after the return from the captivity, as may be learned from the books of Ezra and of the Maccabees, but it was gradually overcome by the leaders of the nation, and ultimately it entirely disappeared. In the early Christian Church idolatry was considered one of the highest and gravest crimes a believer could commit. There are not many references to it in the New Testament, though the lawfulness of eating meat offered to idols is considered and decided by St. Paul, but Christianity from the first came into open collision with Greek, Latin, and Celtic idolatry. During the periods of persecution the heaviest ecclesiastical censures were awarded to all those who through fear of punishment consented to enter heathen temples or burn incense to any idol; and all those who assisted in any way in such worship, by making idols, selling incense, or building temples, came under the ban of the church. By the laws of Constantius and Theodosius idolatry was declared treasonable, and was punished with death.

Most of the various forms of idolatry will be found under the names of their chief deities, or described under the countries where they have been or are practised. For the consideration of the use of images in Christian worship see IMAGE WORSHIP. See also ICONOCLASM.

IDOM'ENEUS was the son of Deucalion in the Greek mythology, the grandson therefore of Minos, whom he succeeded in his kingdom of Crete. He took part in the siege of Troy, bound by his suitor's oath; for he had been a suitor for Helen, and had, like the rest, sworn to defend her husband, whichever prince she proved to have taken. It was while Menelaus was at the court of Idomeneus on a visit that the abduction of his wife Helen was effected, and the news was first brought thither to the injured prince. A form of the legend of Jephthah's daughter and of

Iphigenia (Jephthah-geneia) is told of Idomeneus—namely, that he vowed to Poseidon whatever of dearest he met upon landing safely at home after the siege of Troy. He did reach Crete safely, and the first object he beheld was his own son. He kept his horrid oath, and his indignant subjects drove him forth. Various accounts exist of his wanderings after this.

IDUMÆ'A, usually called *Edom* in the New Testament, included, in the time of Christ, a considerable portion of the southern part of Palestine, and extended south-west as far as the Lake Serbonis; but in the Old Testament it was used to designate the mountainous district north of Arabia, which extended from the south of the Dead Sea to the Bay of Ælana in the Red Sea. The Edomites, who were descendants of Esau, originally dwelt on Mount Seir. They were governed by kings from the earliest times, and appear to have possessed considerable power when the Israelites invaded Canaan. They were defeated by Saul, and were made tributaries of the Jews during the reign of David.

After the division of the Jewish kingdom, the Edomites continued subject to Judah till the reign of Joram, when they again established their independence. They were subdued again during the reigns of Amaziah and Uzziah; but in the reign of Ahaz the Syrians seized upon Elath and drove the Jews out of Edom. Edom, in common with the rest of Syria, appears to have been subdued by Nebuchadnezzar; but after the downfall of the Babylonish Empire, the Edomites are again mentioned as an independent people. They appear about this period to have been driven from their original settlements by the Nabathæi, who are supposed to have been descended from Nebajoth, the eldest son of Ishmael. The Edomites were constantly at war with the Jews after the return of the latter from Babylon, till they were entirely subdued by John Hyrcanus. From this time the Edomites were regarded as a part of the Jewish nation, and were governed by a prefect appointed by the Asmonæan princes of Judæa. One of these governors, Antipater, a native of Idumæa, was appointed by Julius Cæsar procurator of Judæa, and was succeeded by his son, the celebrated Herod, who put an end to the dynasty of the Asmonæan princes. The Idumæans marched to the assistance of Jerusalem when it was besieged by Titus, and entered the city; they did not, however, continue in it till it was taken, but returned to their own country laden with plunder. We have no further mention of the Idumæans in history. Origen, in his "Commentary upon Job," informs us that the name of Idumæa did not exist in his day, and that the inhabitants of the country were called Arabs, and spoke the Syriac language.

Ptolemy is the only author who applies the name of Idumæa to the country west of the Jordan. The whole of Judæa was frequently called Idumæa under the Roman emperors.

IDU'NA, one of the goddesses of the Norse mythology, wife of Bragi, god of poetry. Iduna dwelt in the underworld, and kept close the golden apples of the Ases (gods) wherewith they daily renewed their youth. The storm-giant Thiassi once stole Iduna, and the Ases grew gray and withered. The fire-god Loki stole her back from the giant, who, pursuing his prey, was caught by the Ases and killed. Here we doubtless have the youth of the earth apparently stolen away in winter while all nature is wrinkled and gray; the warm south wind and the beams of the returning sun free the forces of nature, and as soon as winter puts forth his last efforts he is slain. The final departure of Iduna and Bragi (youth and song) forms one of the gloomiest presages of the downfall of the Ases, the prophesied time of convulsion called Ragnarok.

I'DYLL (Greek, *eidullion;* Lat. *idyllium* or *eidyllium*) is a poem in which the appearances of external nature, or manners and sentiments, or both, are described. The bucolic poems of Theocritus are called idylls; and all the bucolic poetry [see BUCOLICS] may be included under this name, though the ancients did not, any more than ourselves, confine the name to pastoral poetry. The "Idylls of the King," by Tennyson, are epic in their style and treatment, and romantic and tragic in their incidents. The Greek idyll has been styled by Sterling an anecdote drawn from rustic life and rounded into song.

IGASURIC ACID is an acid found in combination with strychnine in nux vomica, *Strychnos Nux vomica*, natural order Loganiaceæ, and in *Strychnos Ignatia*, or Ignatius' bean. It resembles lactic acid, but differs in forming a precipitate in solution of acetate of lead. It forms salts called igasurates, mostly soluble in water and alcohol.

IGASURINE is an intensely poisonous alkaloid found in nux vomica, with strychnine and brucine. It crystallizes in silky prisms, is soluble in water, especially when boiling, and in alcohol, but insoluble in ether. It dissolves in acids, forming salts, which are crystallizable. The solutions are precipitated by the alkalies, the precipitate being soluble in an excess. It assumes a rose colour with sulphuric acid, and deep red with nitric acid; the same reaction as with brucine. The formula is probably $C_{22}H_{26}N_2O_3$.

IG'DRASIL. See YGDRASIL.

IGNA'TIUS' BEANS are the seeds of a species of STRYCHNOS.

IGNA'TIUS LOYOLA. See LOYOLA.

IGNA'TIUS, ST., Bishop of Antioch, one of the apostolical fathers, is said to have been a disciple of St. John. But little is known of his history beyond the facts of his meekness, gentleness, piety, and courage, and that he suffered martyrdom at Rome during the reign of Trajan, being torn to pieces by the wild beasts in the arena. The date of this event is by some recorded as 107 A.D., but other authorities make it 116 A.D. The martyrdom of Ignatius is celebrated in the Roman Catholic Church on 1st February, and in the Greek Church on 20th December.

The writings which have come down to us as the epistles of Ignatius have for a long period been the subject of much controversy. That he was the author of some epistles which were known and quoted in the second and third centuries is tolerably certain, but of the fifteen that are now extant eight are almost universally rejected as spurious by scholars, and great differences of opinion exist as to the remainder. They are addressed to the Ephesians, Magnesians, Philadelphians, Trallians, Smyrnæans, Romans, and to Polycarp, and they have come down in two different Greek recensions distinguished from each other as the longer and shorter. Some scholars have regarded the whole as spurious, while others have contended for the genuineness of the longer or the shorter forms. The circumstance that has given keenness to the controversy is that the longer form of these epistles is marked by references to the dignity and authority of the bishops and to the divinity of Christ that are wanting in the shorter recension. Hence the advocates of the apostolic origin of Episcopacy have felt bound to defend, by all the ingenuity at their command, the genuineness of the longer version; but on the other hand the defenders of Presbyterianism have been equally zealous in support of the shorter form. The controversy received a fresh impetus by the modern discovery in a convent of the Egyptian desert of Nitria of a Syriac version of the epistles to the Ephesians, Romans, and to Polycarp, which were shorter even than the short Greek copies, the passages in favour of Episcopal authority and the divinity of Christ being chiefly omitted. (See "The Ancient Syriac Version of the Epistles of St. Ignatius," by W. Cureton, London 1845.) The most probable view of the seven epistles is that which contends for a basis of genuineness, but at the same time admits that they have

received large interpolations. They have been several times translated into English, the edition of Archbishop Wake being the best known.

IG'NEOUS ROCKS, in geology, are considered to have been originally in a pasty or more or less fluid condition, resulting from igneous fusion, and to have either been outpoured on the surface of the earth or else to have consolidated beneath this surface, and subsequently to have been exposed by denudation. As a class they are opposed to SEDIMENTARY or STRATIFIED ROCKS, which have had their origin in water, either through the accumulation of the debris of pre-existing rocks, or through the secretive power of certain organisms. Igneous rocks, on the other hand, are devoid of both fossils and true stratification, or the lamination produced by the sorting power of water on mixed material. They are usually more or less crystalline. Many are composed of an aggregation of crystals with an interstitial paste or magma; while comparatively few are wholly crystalline, and still fewer are entirely vitreous or glassy. Their mode of occurrence and structure are also quite distinct from the derivative rocks: for not only do they occur in bosses, dykes, and tortuous veins, penetrating and protruding through these strata, but beneath the stratified rocks igneous rocks are always found; so that there can be little doubt that the crust of the earth, within a comparatively short distance of its surface, is largely composed of this class of rock, and that in some cases it still remains in a pasty or partially fluid condition, thus supplying volcanoes with molten material.

The resemblance between modern lavas and many of the igneous rocks throughout the geological record shows conclusively that both have had a similar origin. The connection between these ancient lava-flows and many of the less vitreous dykes and tortuous veins found penetrating strata can often be traced, showing that although the rocks differ in structure they have both proceeded from the one root, which not uncommonly is found to be some of the more crystalline bosses or masses of granite or kindred rock. The effect of igneous rocks on adjoining strata also supports the inference of their having been at some time in a highly heated condition, which indurated and baked the contiguous portion of the surrounding formation.

Igneous rocks usually consist of two or more distinct minerals, either aggregated together or scattered through a felsitic or vitreous ground mass. The rock-forming minerals are almost exclusively some of the numerous silicates of alumina, the alkalies, and alkaline earth. Silicic acid is almost invariably present; it is often free in the form of quartz, but a large proportion is always combined with the bases. The most commonly occurring silicates are the felspars.

The classification of the igneous rocks in a satisfactory manner is rather a difficult matter. Although they form but a small proportion of the total mass of rock appearing at the surface of the earth, there is yet a far greater variety among them than among sedimentary rocks. In classifying them the chief points to be taken into consideration are:—

(1) Their *mineral composition* and *ultimate chemical constitution.*

(2) Their *internal structure*, whether it be wholly crystalline, or only partially so, or vitreous.

(3) Their *mode of occurrence*, whether it be in irregular masses or bosses; in intrusive sheets, dykes, or tortuous veins; or in flows contemporaneous with the adjoining strata, these indicating their origin, whether they consolidated at a depth beneath the earth's surface, or near or upon that surface.

As rocks are usually determined by their mineral components, and as the conditions under which the molten mass solidified and cooled down largely influences the development of its mineral constituents and their aggregation, a primary division of the igneous rocks may be made on their mode of origin and crystalline structure.

(*a*) *Plutonic* or *intrusive rocks*, those which have consolidated beneath the surface of the earth, and have a more or less crystalline structure, being aggregations of distinct minerals without, or with only a small proportion of glassy matrix.

(*b*) *Volcanic* or *interbedded rocks* have consolidated near the surface of the earth, and not being subject to much pressure, and having cooled rapidly, the mineral constituents have not crystallized out extensively; these latter are generally either finely crystalline, with much interstitial paste, or are almost wholly vitreous.

Each of these groups is subdivided into acid and basic rocks, according to the amount of silicic acid present, either free or combined; and these are again split up into numerous members, according to their mineral composition and structural peculiarities.

In *basic rocks* the silicic acid does not exceed about 50 per cent.; it is only sufficient in amount to combine with the bases present to form the lower silicates; there is therefore no free quartz.

In *acid rocks*, on the other hand, the silicic acid exceeds 70 per cent., and generally a portion remains free, which occurs in the rock as crystalline quartz.

A more scientific lithological classification is often made by dividing igneous rocks primarily into *acid*, *intermediate*, *basic*, and *ultra-basic*, and subdividing each of these groups according to their structures and constituents.

The *acid rocks* have a high percentage of silica, ranging from 74 to 80 per cent.; their specific gravity is low, being about 2·3 or 2·6; as a rule they do not decompose readily, but vitreous or glassy varieties are more abundant than in the other groups. Quartz is one of the most characteristic minerals; orthoclase predominates over plagioclastic felspar; hornblende is not an uncommon constituent, but augite is seldom present; muscovite or potash mica is common; olivine never occurs. Granite, rhyolite, and obsidian are common examples.

The *intermediate rocks* seldom contain free quartz; the amount of silica ranges from 50 to 60 per cent. Orthoclase and plagioclastic felspar occur, often together. According to the predominance of the felspar this group is subdivided. The *trachytic members* are those in which orthoclase predominates, such as syenite and trachyte; the *andesitic*, those in which plagioclase is more abundant: diorite and andesite are examples. When the felspars are largely replaced by nephaline or one of the leucite group (sodalite, haüyne, &c.), the rocks become phonolitic, as ditroite, miascite, leucite-porphyry, phonolite.

In the *basic rocks* the percentage of silica is low, varying from 45 to 55 per cent., while the percentage of the alkalies and alkaline earths is high. The specific gravity is high; quartz is seldom, but olivine is usually present. Examples are gabbro, diabase, dolerite, basalt, and tachylite.

The *ultra-basic rocks* are easily decomposed and of high specific gravity. They are not an abundant group, but compose such rocks as augite rock, Lherzolite, &c.

IG'NIS FA'TUUS (Lat., foolish fire), a luminous meteor resembling a flame which floats in the atmosphere a few feet from the ground in marshy places, over stagnant pools, and sometimes in churchyards. It generally appears a short time after sunset, and it lasts till early morning, though there is no reason to suppose the flame is absent during the day, but only invisible. The flame, which is pale blue in colour, is sometimes fixed over one spot, but more generally it travels with great rapidity, receding on being approached. In former times when roads were scarce it formed a source of danger to the traveller from its resemblance to the flame of a lantern, and when followed was apt to lead into dangerous swamps or pools. It is now a rare phenomenon, and is seldom seen except in the

swampy and moorland districts of England and the lowlands of Scotland, and in the marshy lands of North Germany, where it is most commonly found during the autumn.

Many attempts have been made to account for this phenomenon, but no satisfactory explanation has yet been given, and the appearance has never been produced by artificial means. The opinion most generally received is that it is caused by a phosphuretted hydrogen gas produced by the decomposition of animal matter rising from the ground and taking fire spontaneously when it reaches a drier atmosphere. Another theory is that it is caused by the combustion of light carburetted hydrogen or marsh gas, which, however, is not spontaneously combustible. It was formerly an object of superstitious dread among the peasantry, who saw in it the trick of a goblin or evil spirit to lure travellers to their destruction, and it received a variety of names, of which *Will-o'-the-wisp*, *Jack-a-lantern*, and *Spunkie* are the most common.

IGNITION. See INCANDESCENCE.

IGNORA'MUS (Lat., we do not know), the endorsement formerly written by a grand jury when there was not sufficient foundation for the prosecution. It corresponds to the words "not a true bill," which are now used. The ordinary use of the word ignoramus at present is to signify a foolish fellow.

IGNORAN'TIA JU'RIS, or *Ignorance of the Law*, does not legally excuse a man from the consequences of offences against it. It it were not so, and crimes or social delinquencies were allowed to go unpunished because the offender was ignorant of the law, it would be placing a premium upon ignorance, and such a plea would lead to endless inquiries as to the state of a man's mind. It is, however, sometimes taken into account when passing judgment, and a more lenient punishment awarded.

IGNORAN'TINES (Fr. *Frères Ignorantins*), the common name for the Brethren of the Christian Schools, a religious fraternity founded at Rheims in 1679, by the priest Jean Baptiste de la Salle, for the gratuitous instruction of poor children in secular as well as sacred learning. The brethren are not allowed to take holy orders, but they take the vows of poverty, chastity, and obedience, and they wear a distinctive dress, consisting of a cassock and hooded cloak with hanging sleeves of a coarse black material, and a broad-brimmed hat. The order received the approval of Pope Benedict XIII. in 1725, and soon acquired great influence over education in France. Expelled at the time of the Revolution they were allowed to return by Napoleon I., in 1806, and received the formal recognition of the French government in 1808. Since then the progress of the brotherhood has been rapid and extensive, and in France they have over 1800 schools attended by more than 300,000 pupils. They have numerous branches in Italy, Germany, Bohemia, and Ireland, and a few also in England and America. They have brought the methods of teaching to a very high state of perfection, and in some respects their best schools are in advance of those which in the different countries are carried on under government supervision. A number of their educational appliances, school books, &c., were exhibited at the Health Exhibition in London in 1884.

IGUAN'A, a genus of lizards belonging to the family IGUANIDÆ. The genus Iguana, as at present restricted, contains only three species, natives of Brazil, Cayenne, the Antilles, the Bahamas, Mexico, &c. They attain to considerable dimensions, and have a fierce and strange aspect. Their flesh is esteemed a delicacy. The iguanas (or guanas) are characterized by a cutaneous expansion, like a pendent dewlap or flaccid pouch, under the lower jaw and throat, which is capable of being inflated; and there are cuticular folds on the lateral regions of the neck and throat. The head is stout at the base, moderately long, and of a somewhat pyramidal shape, covered with plates forming a sort of tesselated pavement. The scales of the body are small, almost lozenge-shaped, slightly keeled, and but little imbricated. A serrated dorsal crest, consisting of elevated, compressed, and pointed scales, runs along the ridge of the back, and also of the tail to its tip. The tail is of great length, very flexible, and laterally compressed. The orifice of the ear is covered by a large tympanic membrane, and generally there are several large scales about the angle of the lower jaw. The limbs are long, while the toes are unequal and rough, have elevated points on the under surface, and are armed with acute claws. A range of tuberculous pores runs along the inside of each thigh.

The iguanas are arboreal in their habits, and feed principally on vegetable aliment. These animals haunt the borders of water, into which they often plunge and swim with great velocity, lashing their tail from side to side. During the pairing season the male is very savage, watches over his mate, and defends her with fury. The female deposits her eggs along the margin of rivers, in savannahs, or on the sea-shore, burying them in the sand. Both the eggs and the flesh of these animals are in great request, insomuch that in some of the islands where the iguana was very common, as, for example, Jamaica, it is now very rare. They are taken by nooses, in traps or nets, and sometimes are hunted by dogs. They are very tenacious of life, and as they struggle violently, snapping at every person, are generally despatched as soon as captured.

The Common Iguana (*Iguana tuberculata*) is a native of Brazil, Cayenne, the Antilles, and the Bahamas. It attains to a considerable size, sometimes measuring 6 feet in length, including the long tail. The colour of the iguana is yellowish-green below, and above of a green more or less deep, becoming sometimes bluish, and sometimes a slate colour. They are timid animals, protected from their enemies by their colour, which, according to Wallace, "renders them almost invisible when resting quietly among foliage." Formerly this species was an important article of commerce in the Bahamas, and cargoes of living iguanas, or salted iguanas, and also of their eggs, were imported into the Carolinas.

IGUAN'IDÆ is an extensive family of lizards, forming with the family Agamidæ the suborder Strobilosaura. This family is, with one exception, confined to America, being especially abundant in the tropical regions of the southern continent. The genus Brachylophus is alone found in the Old World, occurring in the Fiji Islands. About 240 species have been described. In this family the dentition is *pleurodont*. The teeth are round at the root, dilated, compressed at the tip, and toothed on the edge; they are placed in a simple series in a furrow on the inner side of the jaws, just below the edge, and covered on the inner side by the gums. They are replaced by the young teeth, which grow at the base of the old ones, and gradually cause the absorption of their roots. The palate is furnished with one or two rows of teeth on each side. The greater proportion of the species have a horny crest or ridge extending along the middle line of the back and tail; and many have a compressed dewlap or pouch under the throat, while others have only a fold of the skin there. The toes are free, distinct, and all furnished with nails or claws. In general they are nimble in their movements, and are very quarrelsome, fighting with great ardour when they meet. The compressed and very long tail of many of them is most useful as an organ of progression when swimming across the inundated savannahs; for though they are not amphibious animals, they do not fear or dislike the water. As many of them live on trees their long hooked claws are useful in climbing, and assist them in pursuing the smaller animals upon which they partly feed, enabling them the better also to reach the fruits, and

grains, and leaves which in many species form their usual sustenance. One species, *Amblyrhynchus* or *Oreocephalus cristatus*, is peculiar to the Galapagos Islands, swimming in the sea and living exclusively on seaweed. The typical genus is IGUANA. Other genera included in this family are Cyclura, ANOLIS, Basiliscus [see BASILISK], Trachycephalus, &c.

IGUAN'ODON is the name of an extinct gigantic reptile belonging to the order DINOSAURIA, whose remains were discovered by Dr. Mantell in Tilgate Forest, Sussex. Fossil remains of the iguanodon have been found chiefly in the WEALDEN clays. A wonderful discovery of iguanodon remains was made in 1878 at Bernissart, near Brussels. Skeletons of no less than twenty-three of these huge reptiles were found, most of them in a very complete state. The iguanodon presents many important resemblances to birds. It was herbivorous in its habits, living in marshes and feeding largely on ferns. This huge reptile was over 14 feet in height, and had somewhat the shape of a duck, with the addition of a long tail shaped like that of a crocodile. The body and head were laterally compressed. The neck was slender and very flexible. There can be no doubt that the iguanodon walked upon its hind legs like a bird. The hind legs are much longer than and different in structure to the fore pair; the hind feet only having three toes, while the fore feet have five. Now, of the eight Dinosauria known from the Wealden, iguanodon is the only one which could leave tridactyle footprints. The pentadactyle impressions which would have been left by the fore feet are not found in connection with the tridactyle footprints. It has been proved that the hind feet of iguanodon fit exactly the Wealden footprints. M. Dollo, who has been investigating the Bernissart collection, sums up as follows:—"In short, the position of the occipital condyle, the length and the mobility of the neck, the rigid attachment of the dorso-lumbar region to the pelvis, the number of the sacral vertebræ, the massive nature of the tail, in fact the entire structure of the vertebral column, agree in demonstrating that iguanodon was biped in its gait." The hand, as has been before mentioned, had five fingers. The thumb formed a huge spur, which was probably covered with horny matter. These spurs, having been found detached from the hand, were formerly supposed to be the cores of nasal horns. The vertebræ were solid. According to Professor Marsh clavicles were present, but M. Dollo considers the bones which Marsh takes for clavicles to be in reality sternal plates. The pubis was very large, the post-pubis long and slender. The front portion of both jaws was destitute of teeth, but was probably during life covered with a horny beak. In the hinder part of the jaws are ninety-two teeth, resembling those of the iguanidæ. The skin was either quite naked or covered only with epidermic scales. It is not improbable that there was a slight web between the toes to aid the reptile in swimming; the tail formed a powerful swimming organ. The erect position assumed by the iguanodon on land enabled it to notice at great distances the approach of its enemies, for there were giants in those days, and the huge carnivorous reptile the megalosaurus must have proved a terrible foe even to the earth-shaking iguanodon. Probably the iguanodon, when attacked, seized its foe in its short arms and stabbed it with its dagger-like thumbs.

Three species of iguanodon are distinguished. The original species of Mantell is *Iguanodon Mantelli*, with five sacral vertebræ and the fore limbs half the length of the hinder pair. *Iguanodon Prestwichii* has four sacral vertebræ. The third species, *Iguanodon Bernissartiensis*, has been found in the greatest abundance at Bernissart, twenty-one out of the twenty-three skeletons belonging to this species. It is larger than *Iguanodon Mantelli*, and the disproportion in length between the fore and hind limbs is not so great. It has six sacral vertebræ.

IKA'RIOS, in the Greek mythology, received the god Dionysus kindly in Attica, and in return was taught the secret of wine. He gave some away, but the peasants, who drank it too eagerly, thought he had driven them mad, and in revenge slew him. Dionysus placed him among the stars as the constellation Boötes (containing the brilliant Arcturus), and the faithful dog who guided his daughter Erigone to the grave of Ikarios was likewise translated as the constellation Procyon (containing Sirius), Erigone, who died on her father's grave, becoming the constellation Virgo. Ikarios was also the name of the father of the famous PENELOPE, wife of Odysseus (Ulysses).

IK'AROS or **IC'ARUS**, in the Greek mythology, was the son of Daidalos or DÆDALUS.

IK'ENILD STREET was one of the four great Roman roads which crossed Britain in the time of the Roman occupation. Beginning on the east coast it struck inland at Norwich, and passed through Newmarket, Dunstable, and Winchester to Southampton. It was roughly the chord of the long arc of Roman forts which extended from the Wash round the east and south coasts to Southampton. Its course may yet be traced, but with large breaks. It crossed Irmin Street at Dunstable (*Forum Dianæ*), and we meet it again in Oxfordshire, where it leads across the Thames to the junction of the great Roman roads at Silchester, and in Bucks as Iknell Way. Thence it passed to Winchester, then divided into the Southampton and the Sarum branches. The Ikenild Street has sometimes been confounded with the quite distinct *Rykenild Way*, which lies along an old Roman road from Gloucester to Doncaster.

IL'CHESTER or **IV'ELCHESTER**, a town of England, in the county of Somerset, derives its name from the river Ivel or Yeo, on which it stands. It is 128 miles from London, being 5 miles from the Yeovil station of the London and South-western line, and stands in a rich broad marshy valley, and consists of two parts, Ilchester proper and the village of Northover, separated by the river Yeo, which is crossed by a stone bridge of two large arches. Ilchester proper consists of four streets of indifferently built houses. The church, an ancient structure, has a low octagonal tower. The town-hall is a neat modern building at one end of the market-place. Ilchester, the chief seat of the Belgæ, and the Roman *Ischalis*, was the birthplace of Roger Bacon, in 1214. It had 108 burgesses at the time of the Norman Conquest, was made the assize town for Somerset by Edward III., and sent two members to the House of Commons until 1832. It is now only worthy of notice for its former importance, and has but 683 inhabitants.

ILE-DE-FRANCE, one of the old provinces of France, was bounded N. by Picardy, W. by Maine and Normandy, S. by Orléanais, and E. by Champagne. It now forms the departments of Seine-et-Oise, Seine-et-Marne, Aisne, Oise, and parts of Eure-et-Loire, Loiret, and Yonne. Paris was its capital. This province formed part of the monarchy under the first kings of France, and was governed by the dukes or counts of Paris, who were numbered among the great vassals of the crown. It was united to the crown in the year 987 under the reign of Hugh Capet.

ILEO-CÆCAL VALVE, that most important valve which guards the junction of the great with the small intestine, protecting the ileum against any regurgitation of the fæcal matter. It consists of two semilunar folds of mucous membrane strengthened by the muscular fibres of the intestine.

IL'EUM, one of the three great divisions of the small intestine. It is about $10\frac{1}{2}$ or 11 feet in length, and is thus more than half the length of the entire small intestine. It forms the lowest portion, and opens into the large intestine by the ileo-cæcal valve.

IL'EUS, or **IL'IAC PASSION**, is the name given in old medical works to what used to be considered a distinct

disease, but which is now known to be a consequence of the severest forms of enteritis, colic, or intestinal obstruction. It is characterized by intense pain, obstinate vomiting, frequently terminating in a discharge of fæcal matter by the mouth, collapse, and death. The disease is always one of the most serious character, requiring prompt and skilful medical treatment, and even this is often unavailing. Sometimes, however, when the most severe symptoms of internal strangulation have been exhibited, relief has come almost as suddenly as the onset of the disease, through the bowel recovering its natural position.

I'LEX is a name given to two very different plants. As that of a species it indicates the evergreen oak of the south of Europe, or *Quercus Ilex;* as that of a genus it belongs to the Common Holly (*Ilex Aquifolium*). The genus belongs to the order ILICINEÆ (or Aquifoliaceæ). Its characteristics are the following:—There are four (sometimes five or six) petals, united at the base; the stamens are of the same number as the petals; and the ovary has four or five cells.

Besides the common HOLLY and its numerous varieties, the genus Ilex comprehends a large number of species, the most remarkable of which are the *Ilex balearica*, or broad-leaved species of Minorca holly, a very handsome kind, with yellowish-green leaves: it is hardy in the middle and south of England; the *Ilex vomitoria*, or Cassena tree of the North Americans, whose leaves possess strongly marked emetic qualities; and the *Ilex Paraguayensis*, or maté plant, of whose leaves a very large consumption takes place in South America under the name of PARAGUAY TEA. The leaves are dried, and afterwards used like the common tea.

IL'FRACOMBE, a seaport of England, in the county of Devon, and a fashionable and romantic watering-place, situated on the Bristol Channel, 210 miles from London by the South-western Railway, and 10 miles north from Barnstaple, with which it was connected by railway in 1874, and to which port it is tributary. The old town consists of one main street extending along the sea-coast, and reaching at the north-east end to the harbour, which is formed by an inlet or cove of the Bristol Channel, very commodious and safe, affording anchorage to vessels of 230 tons burden, and rendered additionally secure by a pier 850 feet long. This portion of the town is backed by fine terraces covered with handsome residences, and is almost inclosed by beautifully wooded heights. Good bathing on a sandy bottom is afforded in some small coves at the bottom of the rocks. The Church of the Holy Trinity, a large and ancient structure, at the western end of the town, has been thoroughly restored throughout. There are other churches and places of worship for Wesleyans, Baptists, Independents, and other denominations. The town contains a town-hall, market-house, excellent baths, and commodious public rooms, and of late years it has been much resorted to as an agreeable summer residence. The walks cut through the cliffs and rocks are greatly admired for their beauty. The warmth, salubrity, and the bright picturesque character of the scenery render Ilfracombe particularly suitable for invalids. A splendid hotel was opened in 1867, and visitors can now find every necessary accommodation either there or at the numerous villas, terraces, and lodging-houses. The population in 1881 was 6255. The name, which means "Alfred's coombe or dingle," is variously spelt in ancient writings, Ilfordscombe, Ilfarcombe, Alfredscombe, and Ilfridcombe. The town was of considerable importance in the time of Edward III., and suffered in the cause of the Parliament in 1644.

IL'IAD. This incomparable poem, or collection of poems, at once the earliest and the most majestic work of Greek literature, is so thoroughly the fountain and source of a large part of the Greek mythology that a brief connected account of its contents and the myths accompanying it is necessary. For the form of the work it is sufficient to say that it is in twenty-four books, named by the letters of the alphabet, is written in Ionic Greek of an antique type, and in perfect hexameters throughout, whose exquisite melody and whose marvellous power of suiting the musical sound of the words to the sense they convey has always been and still is nothing short of a miracle. No explanation of such wondrous skill at such an early date has ever been given. The detached nature of many parts of the Iliad, from which whole books could be removed without injury to the general plan, points to a collection, possibly to a re-writing by one poet, of several separate archaic poems, rather than to the invention of a single man, as the source of the Iliad. The work as we know it is the result of a critical recension of the text in the time of Pisistratus, the beneficent and art-loving tyrant (absolute ruler) of Athens. The first and eighth books, and books eleven to twenty-two, are often styled the *Achilleis*, and represent the main plot, the anger of Achilles and its fatal results. The other books, though, as we possess them, evidently by the same hand, would appear to be later additions, enlargements of the original plan. The date of the composition of the Iliad given by Herodotus is 850 B.C., and is probably within a century of the truth. The Iliad and the Odyssey, the first treating of episodes in the siege of Ilion (Troy), and the latter of the adventures of one of the heroes, Odusseus or Odysseus (Lat. *Ulysses*), on his return from that siege, were universally held in antiquity to be the work of Homer; but they were only two of a vast series of poems which, since they included the whole cycle of heroic mythology, were called the Epic Cycle. All of these poems, except the Iliad and the Odyssey, are now lost; their names and contents are, however, known, and later poets reproduced them in other ways. The following may serve as an approximate list of the chief of them—Titanomacheia (War of Titans and Gods), Danaïs, Amazoneia, Oidipodeia (the myths of the family of Oidipous or Œdipus), Thebais and Epigonoi (the first and second Theban expeditions, forerunners of the Trojan wars), Kupreia or Cypria, Iliad, Æthiopis, Lesser Iliad, Ilioupersis (or Taking of Troy, written by Arktinos, who flourished about 776: the poem worked upon by Virgil in the Æneid), the Returns of the Heroes, and in especial the return of Odusseus (the Odyssey); finally, the Telegoneia (of Eugammon, B.C. 566, narrating the death of Odusseus at the hands of his son Telegonos, whom the sorceress Circe had borne to him). This cycle was actually collected in one great arrangement by the Alexandrian literati about 200 B.C.; but much of it was found so very inferior to the Iliad that the term "cyclic poet" became a reproach. It was not well deserved, so far as we can judge by fragments preserved to us in quotations.

The Iliad, then, represents in itself or by implication the tale of the fall of Troy; and especially the delay in that event through the quarrel of Achilles with Agamemnon. It remained for about two centuries unwritten, transmitted by oral tradition only; and it was to stay the growing discrepancies of the various versions that the Pisistratid canon was laid down.

The Iliad, like all Greek legends, rests on the inexorable power of a mysterious destiny. The Trojan War rose out of the intertwined fates of Helen and Paris. Helen (Gr. *Helena*) was the daughter of Zeus by Leda, wife of Tyndareus. She was so lovely that all the princes of Greece were ready to fight for her hand. Her nominal father therefore engaged them all to promise to abide by the choice of the princess herself and protect the favoured suitor. Helen chose Menelaos, king of Sparta, the son of Atreus and brother of the most powerful prince of Greece, Agamemnon. Paris was the son of Priam, king of Troy, a town on the Asiatic shore of the Hellespont.

In his infancy, alarmed by a prophecy that he should be the ruin of his house, his parents left him exposed on Mount Ida. But the shepherds found him and brought him up, and he became handsome and brave. To the judgment of Paris the three chief goddesses of Olympus submitted themselves that he should decide who was the most beautiful. Eris (Discord) had tossed among them a golden apple, and the "apple of discord" was inscribed "to the loveliest one." Paris hesitated as the three goddesses revealed themselves to him. To warp his judgment Hera tempted him with a promise of unlimited rule, Athena with glory, Aphrodite with the loveliest woman on earth for a bride. To the last, therefore, Paris tossed the apple. Aphrodite quickly caused him to be made known to his family, to sail to Greece, to be welcomed everywhere, and especially at Sparta, where Menelaos ruled. Leaving Helen under the guardianship of Paris the king departed on a visit to Idomeneus in Crete. Paris bore away Helen to Troy in the absence of her husband, the goddess Hera, patroness of marriage-faith, endeavouring to wreck the guilty pair in a storm, but Aphrodite successfully continuing her protection of her favourite. Through her fatal influence Priam and his family received Helen, and determined to resist any attempt on the part of the Greeks to regain her. Menelaos returned to Greece to find his loss. His brother and himself at once called all the princes who had been suitors of Helen upon their oath, and the rest of Greece joined them in one vast armament of over 1000 ships. The second book of the Iliad gives the "Catalogue of Ships," which was to the nobility of Greece what Domesday Book is to our own. Contrary winds delayed the Greeks at Aulis, through the goddess Artemis resenting the slaughter of a favourite stag by Agamemnon. The goddess was only appeased by the sacrifice of Iphigeneia, the virgin daughter of the king.

Nine years did the Greeks fight round Troy, without apparently nearing their end. Fortune was sometimes with them, sometimes with the Trojans and their allies. The Greeks were frequently hard pressed, and had to construct a regular fortification round their ships to avoid being cut off from retreat. Hector, one of the sons of Priam, was the soul of the Trojan defence.

Among the booty of a village on the plain were two beautiful maidens, Briseis and Chryseis. Achilles claimed the first, Agamemnon the second. But Chryseis was the daughter of a priest of Apollo, and the god sent a pestilence upon the Greeks to force them to restore his servant's child. Angry at losing his spoil, and suspecting collusion between Achilles and the Greek priest Calchas, who had declared Apollo's will, Agamemnon took Briseis from Achilles by force. Achilles, the first warrior, though by no means the most powerful prince among the Greeks, at once withdrew to his tent. Disaster on disaster followed. At last Agamemnon, Odusseus, and Diomedes, the three next greatest masters in the art of war, were all wounded in one battle, and things were at their worst. The Trojans were storming the walls of the Greek entrenchments and firing the camps, when Patroklos, a friend of Achilles, begged him to lend him his armour, that at least the semblance of the great chief might restore confidence to the Greeks. The Trojans, thinking Achilles had indeed at last returned to the fight, retreated in a panic; Patroklos pursued, was challenged by the brave Hector, and slain. Then Achilles, moved by his friend's death, consented to receive the apologies of Agamemnon and the restoration of Briseis with many gifts, and sallied forth in search of Hector. The fight when the two heroes met was not long, for Achilles was invulnerable save in the heel, because his mother the goddess Thetis had dipped him in the river Styx in Hades, holding him by the heel, and besides Hector's hour was come. His parting with his wife Andromache, knowing he was probably going to his death, is one of the most admired passages of the Iliad. Achilles, in his fury, disgraced himself by tying the dead Hector's feet to his chariot, and dragging him thus round the walls of Troy. But when the aged Priam came to the camp to beg the body of his son, Achilles gave it up in a ready and even generous manner. Achilles met his own death by an arrow shot by Paris, which wounded him in his unguarded heel. Apollo sped the shaft. In fact the greatest strokes of the heroes throughout the Iliad are due to divine assistance. If their favourites are hard pressed the gods or goddesses cover them with a protecting cloud, or bear them bodily away to safety, or turn aside the flying javelin or the threatening sword. Hera, Athena, and Poseidon were the chief gods fighting for the Greeks; and they were opposed on the part of the Trojans by Aphrodite, Apollo, and Ares. A very fine scene in one of the later epics is where Thetis and Eos, the goddess-mothers of Achilles and Memnon, leave their sons still fighting and fly to Zeus for his help, each against the other. Father Zeus holds out the balance, and Memnon's scale sinks at once. At that instant he falls by the hand of Achilles, and Eos speeds to earth to bear away the body to Æthiopia.

The death of Achilles (we are now beyond the actual scope of the Iliad) was a sore blow to the Greeks. Aias (Ajax) and Odusseus contended for his armour, and when it was awarded to Odusseus his rival went mad, and in his madness slaughtered a herd of sheep, believing them to be men. Eventually he killed himself. A truce was now agreed to, both sides being exhausted. On the resumption of hostilities the Greeks were fortunate enough to seize Helenos, the prophet-son of Priam. Odusseus won from him the secrets of Troy's long resistance. As long as the image of Pallas-Athena, called the Palladion (Palladium), was in the town Troy was safe. This consequently Odusseus, who was as cunning as he was brave, contrived to steal, assisted, according to one version, by the repentant Helen. The possession of the bow and arrows of Herakles, also obtained through Odusseus, powerfully aided in weakening the Trojans, Paris being one of the first victims to fall by them.

By the advice of Odusseus, who received the stratagem from Athena, a great wooden horse was now made, quite hollow, and big enough to hold a small body of the bravest warriors inside. The entire Greek army, except these few, then set sail as if abandoning the war. Laokoön (or Laocoön), priest of Apollo, in vain warned his fellow-citizens to have nothing to do with the horse: his interference even enraged the gods, weary of the war, and two huge serpents issuing from the sea crushed him and his sons to death. A breach was made in the walls and the great horse was dragged into the city, to replace, as they hoped, the lost Palladion. At night the Greeks issued from the horse and opened the gates to the army, which had returned under cover of the darkness. Troy was set on fire in a hundred places at once and burnt to the ground. Only a very few escaped, among them Æneas, son of Anchises by the goddess Aphrodite, and nephew of Priam. From him the Romans claimed descent. The remainder of the heroes had lamentable fates for the most part. Agamemnon, after a ten years' absence, met his death at the hands of his unfaithful wife Clytemnestra; Odusseus did not reach home till after countless wanderings; only a very few had a prosperous return and a happy life after. But the accounts of the two mentioned (the first as represented in the plays of Æschylus, the second in the original form as the Odyssey of Homer) are the only two which have come down to us in a complete condition out of all the mass which once existed.

Such is a bare outline of this famous epic, which has become part and parcel of the life of all the nations of Europe. Poets, painters, and sculptors find innumerable themes from it, and not a day passes but one or more allusions to it crop up in the common talk of daily life.

The Iliad was succeeded by the Odyssey, which we still have, most fortunately; but it was preceded by a lost poem held in all antiquity to be almost equal to it in beauty. Cypria, for that was the name of the lost epic, traced out the beginnings of the fatal quarrel, and told how the heroes came together before the great city in the extreme northwest of "Asia" (Asia Minor). Thus the Cypria or ante-Iliad began with a crowd of incidents and scattered threads, gathering them up into a whole, and ceasing with the first years of the Trojan War; the interest is brought to a focus round a few heroes, of whom Achilles, Hector, Diomedes, Odusseus, Aias, Agamemnon, and Nestor are the chief in the Iliad, and narrowed to the personal interest of one hero in the Odyssey. All are connected into a work of art following a curiously definite plan. But while the Odyssey is not naturally a favourite subject with Greek vase-artists, &c., since it only flattered the small island of Ithaca to have the story repeated, and while the Iliad is rarely their theme, the Cypria, which touched all the tribes of Greece, is universally illustrated. Philoktetes, Telephos, Palamedes, Protesilaos, were all heroes of the lost Cypria; better known episodes are the "Judgment of Paris," the "Marriage of Peleus and Thetis," and the surprise of Troilus and Polyxena by Achilles at the well. A motive, too, is given to the whole legend, in the prayer of Mother Earth with which the Cypria opened, for the ancient goddess, groaning under the weight of the myriads of men moving on her broad bosom, sent up a cry to the gods for relief—and they resisted no longer the pressure of the Fates. The best and bravest of mankind perished by one another's hand, and the common herd fell with them; so only could Mother Earth breathe freely once more.

Nothing is more regretted than the loss of this storehouse of the most ancient myths and legends of Greece. It was attributed to Homer, who married his daughter to a Cyprian named Stasinos and gave him the poem, hence called Cypria (the Cyprian epic), as a dowry. Others maintained that Stasinos himself wrote it.

ILI'CIC ACID is an acid found in the leaves of the common holly, *Ilex Aquifolium*, natural order Aquifoliaceæ. It is found in combination with lime as ilicate of calcium, a salt insoluble in alcohol, but very soluble in water. The acid has not been isolated.

IL'ICIN is the bitter principle of the same plant. It is a brown, bitter, hygroscopic powder, soluble in water and alcohol, but insoluble in ether.

ILICI'NEÆ is an order of plants belonging to the cohort Olacales among the POLYPETALÆ. It is named after the genus ILEX, which contains the common holly and the Paraguay tea plant. The winter berry is another genus of plants belonging to the order.

There are 150 species, several of which are natives of tropical Asia and America, others are found in the temperate regions of the northern hemisphere, while very few grow in Africa and Australia. The calyx is small, with three to six divisions; there are four or five imbricate corolla lobes; hypogynous stamens, of the same number as the petals; no distinct disc, a free globose ovary, with three or several cells; one or two ovules in each cell, pendulous, with dorsal raphe; a drupaceous fruit, with three to eighteen one-seeded pyrenes; the embryo very small in copious albumen. The flowers are regular, generally small, and of a white colour. The species are trees or shrubs with alternate entire leaves without stipules.

IL'ION (Lat. *Ilium*). See TROY, ILIAD.

ILIS'SOS, the little river which flows at the east side of the city of Athens. It originates in Mount Hymettus, and receives the brook Eridanos near the Lyceum. Formerly it spent itself in the marshes, never reaching the sea; now it is still further from that destination, for it gives the main water supply to the city, and is always almost drawn dry for that purpose.

ILI'THYIA or **EILEI'THYIA** (or *Eleutho*) was the goddess of childbirth. Homer speaks of more than one in the Iliad, but the Odyssey, the Hesiodic poems, and later works know of only one. The moon was always held a great favourer of growth among the ancients, and so the curious result comes about that the worship of Ilithyia was confused with that of Artemis, the virgin goddess of the moon, until it almost became a name of Artemis. In other places it seems rather to be a name of Hera; and this was particularly the case with Juno, the Roman goddess correlative with the Greek Hera—for Lucina, which answers to the Greek Eileithyia, is almost the favourite epithet of Juno. At the same time this divinity was worshipped very widely in Greece on her own account, especially by the Dorians of Crete, the Delians, and the men of Attica.

ILIXAN'THIN is a yellow substance extracted from the holly. It is obtained in crystalline needles, melting at 198° C. (388° Fahr.) It is insoluble in cold water and in ether, but soluble in hot water and in alcohol. The formula is $C_{17}H_{22}O_{11}$. It affords a yellow dye when used on cloth with a mordant. It becomes orange with alkalies, and green with perchloride of iron. The lead salt is a yellow powder, forming a colourless solution with acetic acid.

ILK, a term used in Scotland to denote each, every; as *ilk* ane of you, every one of you; and also to signify the same; as, for example, Macintosh of that *ilk* means a gentleman whose surname and the title of his estate are the same; that is, Macintosh of Macintosh.

IL'KESTON, a market-town of England, in the county of Derby, situated in the valley of the Erewash, 9 miles E.N.E. from Derby, and 125 from London by the Midland Railway. The population of the parish in 1881 was 14,122, a considerable portion of whom were engaged in manufactures or in the coal-pits in the neighbourhood. The church has a stone screen in the Early English style of architecture, and is altogether a very fine building. A new chantry chapel has been added to it in modern times. The other principal buildings are the town-hall and mechanics' institute. There are places of worship for all denominations of dissenters. The principal articles made are stockings and lace; there are also manufactories of stone bottles, drain-pipes, and common earthenware, and brick and lime kilns. A warm mineral spring, the properties of which somewhat resemble those of the Seltzer water, was discovered in 1830. The water contains carbonic, sulphuric, and muriatic acids, and lime, magnesia, and soda.

ILLECEBRA'CEÆ, a small order of plants, chiefly consisting of herbaceous weeds, found in the temperate and warmer parts of the world. The species are often conspicuous, especially when dried, for their silvery stipules and shining calyxes, and are sometimes beautiful microscopic objects; but they are too small to be interesting in any other way, and are of no known use. There are about ninety species; the chief genera are Illecebrum, Paronychia, Herniaria, and Scleranthus. The flowers are regular, and of a green or white colour. The perianth is herbaceous or scarious at the margins, persistent, with four or five lobes. The stamens are as many as the perianth-lobes, and opposite to them. The ovary is free and one-celled, with one ovule; there is one style with two or three branches, or two styles (very rarely three). The embryo is curved, excentric, in mealy or fleshy albumen. The species are herbs, more rarely shrubs; the leaves are generally opposite, with scarious stipules. The order is placed by Bentham and Hooker in the series Curvembryeæ of the MONOCHLAMYDEÆ.

ILLE-ET-VILAINE, a department in France, formed out of a portion of the old province of Bretagne, is bounded N. by the English Channel and the department of La Manche, E. by the department of Mayenne, S. by that of Loire-Inférieure, and W. by those of Morbihan and Côtes du Nord. It measures 74 miles from north to south, and

55 from east to west. The area is 2597 square miles. The population in 1882 was 615,480.

Surface.—The department is divided by the Armoric hills into two slopes, one inclining to the English Channel, the other to the Bay of Biscay. It presents a great variety of hill and dale, heaths, moors, forests, ponds, and marshes, which are rendered productive by drainage, or on the coast by banking out the sea. The soil, except in the marsh land, is shallow and light; the most fertile soils are in the neighbourhood of St. Malo, Montfort, and Rennes, and in the marshes north of Dol. The coast, which extends between the embouchures of the Couesnon and the Rance, measures about 40 miles; it is washed by the fine Bay of Cancale; but access to it is much impeded by a great number of isolated rocks and islets. St. Malo in the north and Redon in the south of the department are the most important ports.

The department takes its name from the Ille and the Vilaine, the two principal rivers. The Ille rises near Combourg, north of the Armoric range, through a gap in which it runs south and joins the Vilaine on the right bank at Rennes after a course of about 20 miles. Its waters supply the Ille-et-Rance Canal, which runs a considerable way along the Ille, and then, turning north-west, joins the Rance a little above Dinan. The Vilaine rises a little west of Ernée, in the department of Mayenne, and runs generally west past Vitré as far as Rennes, 5 miles above which it becomes navigable. Having received the Ille at Rennes, its course is S.S.W. past Redon, whence to its mouth in the Bay of Biscay, below Roche-Bernard, it is a tidal river and navigable for vessels of 250 tons. Its whole length is 116 miles, 78 of which are navigable. On the right it receives the Canlache, the Chèvre, the Ille before mentioned, the Meu, and the Oust; on the left its feeders are the Seiche, the Semnon, the Cher (which enters it on the borders of Loire-Inférieure), and the Don and the Isac, which flow from Loire-Inférieure, and are both navigable. The Couesnon rises east of Fougères, and runs first west, then north past Antrain, and enters the Bay of Cancale, below Pontorson, in the department of Manche. It is navigable at high water for barges from Antrain. The Rance is described under COTES DU NORD. The department contains 1,052,446 acres. The railway from Paris to Brest passes Vitré and Rennes.

The farms are small, the largest not exceeding 75 acres, and many not more than 5. The soil is capable of producing all kinds of breadstuffs in quantity sufficient for the wants of the population. In the rich soils wheat of excellent quality is raised; tobacco is grown near St. Malo; rye, barley, oats, buckwheat, and mixed grain are produced in the middling and poorer soils. The cultivation of flax and hemp for the manufactures of the department is very extensive; the flax and hemp in the dressed state, as also the seeds, are important objects of commerce. The apple and the pear are very extensively cultivated for making cider and perry, the chief drinks of the population; the cider is strong enough to keep for two years, and is considered the best made in France. The grass land along the river basins is rich; and as the outlet on the heaths and moors is large, great numbers of cattle are reared, and excellent butter and cheese are made. The honey and wax of the department are also celebrated. There is little meadow land; of artificial grasses only clover is grown. Horses, in general of small breed, sheep, goats, poultry, and pigs of the large white breed are numerous. Game, including wild boars, hares, rabbits, partridges, quails, woodcocks, &c., is abundant. The fisheries on the coast, which are actively plied, yield excellent oysters, soles, lobsters, turbot, skate, crabs, &c. The forests of the department contain fine timber; the prevailing kinds are oak and beech, next come chestnut, poplar, and birch. The cultivated land also presents the appearance of a forest, such is the number of apple trees planted in the fields, and of timber trees in the hedges that separate each field; but as these latter are regularly stripped of their branches to supply firewood, they are of little value as timber.

Several iron mines are worked; roofing and clay slate, white quartz for the glass factories, limestone, and granite are quarried; lead and copper ore are found. Mineral springs are numerous.

The most important manufactures are linen, sailcloth of the best quality, Russia duck, canvas, and shoe and morocco leather; felt and straw hats, sewing thread, thread stockings, ship cordage and ropes, fishing nets, hooks and lines, pottery, cotton and woollen yarn, are also made. There are, besides, several glass-making, tanning, and bleaching establishments, brandy distilleries, paper-mills, iron-forges and smelting furnaces, and flour-mills; in the towns on the coast shipbuilding is carried on to some extent. Salt is made in some of the marshes on the coast. The commerce is composed of the various articles named, and of groats, chestnuts, salt pork, hides, oak staves, firewood, &c.

The climate is damp, but temperate; much rain falls in winter; the prevailing winds are the west, north-west, and south-west; hurricanes are less frequent and less destructive than in some of the more western departments.

The condition of the peasantry is similar, but rather superior, to that of the peasantry of FINISTÈRE. The department contains many Druidical and Celtic remains, consisting of monoliths (menhirs), altar-tables (dolmen, kistvaen), cromlechs, and cairns.

The department is divided into the following six arrondissements—Rennes, Fougères, Montfort, St. Malo, Vitré, and Redon. The capital of the department is RENNES.

ILLEGITIMACY. See BASTARD.

ILLI'CIUM. See ANISE.

ILLINOIS (pronounced *Illinoy'*), one of the United States of North America, is bounded S.E. by the river Ohio; E. by Lake Michigan and Indiana; N. by the parallel of 42° 30′ N. lat.; W. by the Mississippi. The greatest length is about 380 miles, and breadth 210 miles. The entire area is 55,414 square miles, or about 35,500,000 square acres. The population has increased from 12,000 in 1810, to 3,078,636 in 1880.

The Kaskaskia rises on the east side of the state, and, flowing to the S.W. for about 250 miles, falls into the Mississippi about 80 miles above the junction of the Ohio. The Illinois, the largest river in the state, rises near Lake Michigan, and flows W. and S.S.W. into the Mississippi, which it joins 20 miles above the Missouri. This large river takes the name of Illinois only from the confluence of the Plane River from the N.E., and the Kankakee from the E., both considerable streams and navigable for boats. Thirty miles below their confluence the Fox River falls into the Illinois from the north: it rises in the Huron territory, and has a course of 200 miles S.S.W., more than half of which is in this state. The other principal tributaries of the Illinois are the Vermilion River from the S.E., the Mackinaw from the N.E., Spoon River from the N.W., and the Sangamon or Sanganio from the E. The last is by much the largest of these tributaries. Rock River rises in the Huron territory, and entering the state of Illinois on its north boundary, crosses it in a S.W. course of about 200 miles to the Mississippi.

There is a range of low hills near the Ohio, and the western part of the state has an undulating surface; but with these exceptions Illinois is one great plain, having a general slope to the south-west. Its soil consists of exceedingly fertile prairie and timbered land. The minerals are iron, copper, and lead, in the north-western angle of the state. Lead mines are worked, and are very rich. Coal is found in every part of Illinois. Limestones and sandstones are the usual rocks. The climate is much the

same as that of Missouri, except that it is more humid, and in the swampy districts less healthy. The agricultural products of the state are maize, wheat, hemp, flour, tobacco, and fruits. Swine are reared in great numbers from the abundant mast of the forests. There are few manufactures except those of salt from salt-springs. Springfield is the capital, but Chicago is the largest town.

The state is within the limits of the cession which Virginia made to the United States in 1787; but the first settlements made in it were by the Canadian French before 1673. It was governed, with Indiana, as a territory of the United States from 1800 to 1809. In 1809 they were made separate territorial governments, and in 1818 Illinois was erected into a state.

ILLUMINA'TI (Lat., enlightened), a name which at different times has been taken by four societies in Europe. The first, the Alombrados, arose about 1520 in Spain, and were ultimately suppressed by the Inquisition. Another society bearing this name appeared in Picardy in 1623, which ultimately became identified with the Guerinets, enthusiasts and visionaries, who were suppressed in 1635. During the next century it is said a sect also bearing this title lasted from 1722 up to the Revolution in France, but scarcely anything is known of its tenets or practices. The fourth and by far the most important organization was founded on 1st May at Ingolstadt by Adam Weishaupt, professor of canon law, who had formerly been a member of the order of the Jesuits. The objects of the society were the encouragement of reason, freedom, brotherly love, and of opposition to superstition, tyranny, and ignorance. Its religious principles consisted in the acceptance of a system of deism, Christian doctrines and ritual being equally regarded with dislike, while its aim in politics was strongly republican and possibly socialist. Beginning with some of his own pupils, Weishaupt was able to rapidly extend his propaganda, and in the course of a few years members were found in most of the great cities of Europe. Its organization was greatly developed by Baron Adolf von Knigge, who lived at Frankfurt-on-the-Main, and the society entered into intimate relations with the Freemasons. According to the scheme devised by Knigge there were to be three classes of members, the first of which was made up of the novices, the minervals, and the lesser illuminati; the second, of three orders of freemasonry; and the third, of the mysteries, the grades of which were priests and regents, and magus and king. The members of the society on joining took fresh names, generally from classical sources, corresponded in cypher, and bestowed new names on the towns where their meetings were held. To keep the power of the society in the hands of its leaders a plan of mutual espionage was designed, and monthly confessions were enforced. It is said that at one period some 2000 of the most accomplished men in Europe were members of the order, but in 1784 a rupture took place between Weishaupt and Knigge, and in 1785 the Bavarian government issued an edict suppressing the organization. Weishaupt was deprived of his office and banished, and many of the members of the society were severely punished. It is supposed by many that the principles of illuminism introduced to the French Freemasons had an important influence in preparing for the Revolution, but there is not much evidence in favour of the supposition. The founder, Weishaupt, died in 1830 at the age of eighty-three.

ILLU'MINATING is a very ancient art. It may be defined as the ornamentation of manuscripts. In its highest forms illuminating reaches to the dignity of a serious art. While the ordinary monkish scribe contents himself with a flourish here and there, or with decorated titles and headlines or ornamental capital letters, the more skilful and artistic worker uses every device of colour and fancy of form to make the page a blaze of glory. Then steps in the true artist. His capital letters or his borders contain designs, even portraits or small pictures, which have a bearing on the text, and which are in themselves beautiful. The visitor to the monastery of Savonarola, San Marco at Florence, made interesting to Englishmen by George Eliot's "Romola," passes by the library door too frequently. But he who enters there finds in the exquisite illuminations of Fra Benedetto, the brother of the more famous Fra Angelico, some of the most exquisite gems of art possible among the illuminations of the church-books of the monastery. The faces are as delicate and as precious as enamels; the colour not only of the pictures, but of the writing, bordering, and indeed the entire page, a wonder of softness and purity of tint. These give the culminating point of the art.

Illuminating was known and used to a certain extent by the ancient Egyptians, as we can see by the ancient papyri in the British Museum. But the Greeks, who copied the Egyptians in so much else, did not follow them in this mode of art, for they preferred the roll-form for their books. It was not till the square pages came in under the Byzantine emperors that borderings and enrichments began to any extent. But in the fourth and fifth centuries the art, though not high in character, became very gorgeous. Greek MSS. exist, written on purple-stained vellum in characters of gold, of nearly this antiquity. The oldest illuminated MSS. are both of late fourth or early fifth century work—a Dioscorides at Vienna, and a Virgil at the Vatican, Rome. Both contain miniature pictures as well as ornamentations of the text.

It is doubtful whether the Irish and Old English illumination, which rose to great perfection in the sixth century, is derived from the very similar early Lombardic style, or *vice versâ*. Probably the notion of illumination was due to Italy, and the distinctive style was of native origin. Italy would then imitate Ireland. The heathen English were at this time conquering Britain, and all the best powers of Christianity concentrated themselves in Ireland. A well-developed and complete style of interwoven and complex ribbon-like ornament, with frequent dotted borderings and grotesque animal heads ending the ribbons, grew up. As England grew settled schools were founded for the cultivation of this art. St. Dunstan himself is famous to us as an illuminator, and of his school at Winchester we have works. The best Irish MSS. are the very fine "Durham Book" of the eighth century, long kept in Durham Cathedral (now in the British Museum), and the Dublin contemporary copy of the "Book of St. Kells."

Next came the school of Charlemagne, adopting all the gorgeousness of the Eastern methods, but without such a purely architectural style of ornament as was now in favour at Constantinople. This Western or Frankish school rapidly developed an extraordinary fancy for enormous capital letters, some of the largest even reaching the size of 2 feet. After the ninth century this curious extravagance begins somewhat to abate, but does not die out till the end of the eleventh century.

England developed yet another style at the close of the tenth century, so special to this country as to be always called *opus Anglicum*, the finest existing specimen being a copy of the Gospels made for Cnut the Great (Canute). Its spires and pinnacles, crockets and bosses are like a prophecy of mediæval Gothic. Fancy then began to run riot. Another century saw the beginning of the practice of leaving spaces for the illuminator, the scribe only writing the text in a moderately plain fashion. In the thirteenth century the backgrounds of the principal places left for illumination are of gold, upon which the figures are thickly painted; ornament is overcrowded and fantastic, colours are heavy, and the whole effect, though gorgeous and splendid, wants taste. The art now rapidly deteriorated into every excess and extravagance until a sudden change occurred, when in the thirteenth and fourteenth centuries the rise of Italian painting brought to bear upon illumination

the great minds of art. Cimabue, Giotto, Pisano, all took pride in setting the noblest models for the fine-art illuminator—models scarce equalled even by the wonderful finish of the similar works of the Van Eycks and Memling in Flanders during the same periods. The art of the fifteenth century produced the noblest specimens of high art illumination which we possess in the works of Benedetto and Angelico, and others of that magnificent time. In this blaze of splendour the art almost suddenly perished. Its knell was sounded by the invention of printing. It sank at once from the dignified position of a noble ornament to things of real use into a mere luxury. The monochromes of Louis XIV. are among the last specimens—a gray ornament with the lights picked out sharply in white.

The value of this long series of art, often giving us our only portraits of celebrities, always yielding us valuable information on manners and costumes, is quite incalculable. Illuminated MSS. are a mine of wealth, not only to the curious in archæology, but to the most philosophic of historians; and the poor ascetic who wore out his eyes in the dim light of some narrow cell, where the window hole was perforce small if the tenant were not to perish of cold, poring over his hairline strokes of colour, with only the glorification of the divine message before his mind, little thought that he would leave perhaps the only record of men in their habit as they walked whereby their brethren of 1000 years later might know them, and greet them across the ages.

In our Plate we give a chronological arrangement of capital letters, copied from ancient MSS., which conveys some idea of the successive kinds of ornamentation employed. It shows at a glance how the styles varied from the grotesque *Ba.* of the seventh century to the beautiful Italian *O* of the sixteenth, ending with the French *O*, which was executed as late as the reign of Louis XIV.

ILLU'SIONS of sense form a most curious and instructive series of phenomena. Illusions of smell are unfrequent, of taste rather more common, of touch frequent, of hearing more frequent, and of sight the most common of all. The old proverb "seeing is believing" is astonishingly false when scientifically examined. In the list just given it will be observed that the tendency to illusion grows with the delicacy of the sense, and this is a natural consequence. A smell is an actual sensation and but little more—the reasoning powers of the brain do not enter largely into it; but a touch sets the brain off in a train of reasonings and inferences; and what we call sight may, with a little stretch of exaggeration, be said to be far more the work of thought than of sense. Consequently this sense beyond all others is easy to be deluded by anything which sets the mind on a false track of reasoning. Passing over the somewhat obscure cases of smell and taste, which would take too much time to clearly develop, we may give a few instances of illusions of the three superior senses. As regards smell, however, it may be remarked that when the inner nose is galvanized, the negative pole causes a distinct smell of ammonia and the positive of acid; and also we may note the constant presence of evil smells or tastes, due to injury or disease of the sense organs, cases of which are within the acquaintance of almost every one with a wide circle of friends.

Illusions of Touch.—The exaggeration of size when an object touches a sensitive part of the skin, that is, a part where the ends of nerve fibres lie thickly together, is very remarkable. The size of the cavity in a tooth as felt by the tongue, of a tiny grain of sand which has blown into the eye as felt by the eyelids, are cases in point. This can be most remarkably instanced by means of the increasing sensitiveness of the skin of the face towards the lips. If the points of a pair of compasses (not too keen) be set at a certain distance apart and be then slowly drawn across the cheek to the lips, the eyes being closed, it is almost impossible not to believe that the legs of the compasses are moving away from one another, and their width apart when touching the lips is apparently very considerably different to that when touching the cheek near the ear. Again closing the eyes, cross the middle finger over the forefinger, and let a small marble be rolled between them: the *outsides* of the fingers are now touching the marble, and the brain in most persons obstinately persists therefore in feeling two marbles, because in ordinary cases with the fingers in their natural position this sensation could only be gained by two marbles being touched. A painful case of this species of illusion is the frequent itching in the toes felt by persons who have undergone amputation of the leg or foot. The nerves receive some stimulus at their cut ends, and the brain of course refers it to the proper and legitimate source, now, alas, no longer in existence.

Another variety is given by the touch-illusions of temperature. Thus water of a temperature comfortable to the hand is quite intolerable if the whole body be immersed. So, too, water appears much hotter to the hand than to a single finger. Let two bowls of water be prepared, one at 97° Fahr. and the other at 104° Fahr. (as in an experiment of Weber's), and it will be found that a stranger who plunges the whole hand into the first and one finger only into the second will invariably declare the first to be by 3 or 4 degrees the hotter, even with as much as 7 degrees difference *on the other side*—that is to say, he will be deceived by at least 10 degrees. Very low or very high temperatures alike produce the sensation of burning. Sailors in the Arctic regions touching intensely cold metal blister their hands and suffer a scorching pain. This is scarcely to be called an illusion, however, for the burning is a reality; it matters not to the scorched skin whether it was caused by the heat suddenly passing into, or out of, the body. The most amusing illusion of temperature, however, is when the same water is made to feel at once hot and cold. It is not difficult to accomplish this. Take three basins, fill the first with hot, the middle with lukewarm, the third with ice-cold water. Place the hands respectively in the hot and cold basins, then when the temperature has been thoroughly felt, a sudden plunge of both into the middle basin will be attended with the strange result of the same water feeling hot to one hand and cold to the other.

Illusions of Hearing.—These are most common. Every one is either afflicted at some time of life, or has friends afflicted, with singing in the ears of more or less intensity. Cerebral disease or a sudden jar (as in a railway accident) will inflict this misery upon a sufferer for the whole of life. So also a stay in a noisy street will sometimes leave a spectral rattling behind it, which is of some duration, and is very annoying to one used to a quiet country dwelling.

The mind may also be deceived through the fact of our having two ears, as is proved by various experiments where the same sound arrives through two different media, one communicating with one ear, the other with the other. Persons temporarily deaf with the left ear fancy many more sounds come from the right hand than is truly the case, because they hear them on the right; just as persons tapped on the right shoulder turn to the right, while the joker (who was all the time on their left, and stretched across their back to perpetrate his joke) slips off undetected. Or two apparent sounds may be heard with one ear, though only one really exists. Thus let a small bell sound under water, and let a stoutish metal wire reach from the water to one ear, the other being plugged. Two distinct sounds of different quality and power will be heard, the one arriving by the rod, the other by the air.

Cases of auditory illusions of a spectral kind, as the hearing of imaginary voices, &c. (apart from any taint of insanity or delusion), are so extremely common as to need but a mere mention. They are a fruitful source of ghost stories. The illusions of the ventriloquist are pure brain-

illusions, the result of false reasoning, for they depend upon an artificial imitation of the effects of distance upon sound, and are frequently very perfect.

Illusions of Sight.—Of all illusions these are the easiest to produce and the most difficult to detect; and there are few persons who are not daily deceived by their sense of sight. The illusions of the eye due to physical causes are countless. Auditory phantoms are tolerably numerous, but the large family of ghosts depends for its existence far more upon the illusion of the eye than of the ear. Colour-spectra and colour-illusions are remarkable for their variety and intensity. [See COLOUR.] Malformations of the eye are a fruitful source of illusions. But the fact that every image is vertically and laterally inverted on the retina is the parent of far more. Thus, if the eyeball be pressed on the outer side a *phosphene* or imaginary ball of coloured light will appear on the side towards the nose—the brain, as usual, reversing the impression on the retina. As was said in regard to the ear, so also with regard to the eye, if by any means we can make one object give two sensations we perceive it, not as one, but as two objects. For let two pin-holes be made in a card less than a quarter of an inch apart (less than the diameter of the pupil of the eye, in fact), and let a pin-head be viewed through them; two pin-heads will appear quite clearly if card and pin be both held rather close to the eye; indeed, it requires a strong effort of will to be sure there are not two. Conversely two images may be made to seem one, but this illusion depends upon our having two eyes, and of course seeing objects from two view-points at once. If, therefore, by lenses suitably disposed at a proper angle each eye is made to see a distinct flat picture, the two pictures having just the diversity that would appear when the object is viewed by the right eye alone and by the left eye alone, then these two images will coalesce and form one object, which will possess the solidity and relief of nature itself—and this is the principle of the STEREOSCOPE.

A curious illusion of size was probably remarked in the experiment with the pin just given. It may be made clearer by using only one hole. The eye cannot bring to a focus all the rays reflected from an object held at such a small distance as was the pin. But let the outer rays be cut off by means of a pin-hole and the eye deals readily with the rest, with the effect, however, of our seeing a very greatly magnified image, on account of the nearness of the object to the eye, and the consequently larger angle its rays take upon the retina. If a small strip of card be perforated and bent, as in fig. 13 in the Plate, and a pin stuck so that its head comes in the square hole, then applying the eye to that hole, and looking through both holes at a light, the pin will be seen very large, upside down, and apparently at some distance from the eye. Another illusion as to size is given by comparison with known objects. Vast mountains can be depicted by an artist in an inch square, if he will give us a tree or a man to measure by. Thus also the moon or sun when rising or setting, and so measurable against trees or towers of great height, seem double their usual size as seen aloft in heaven without compeers. But let their image be caught on a mirror held above the head, and so brought into the usual position for the eye, and they resume their usual size. Glancing in turn at the horizon and at the mirror the heavenly body appears to shrink and swell most curiously.

The persistence of vision is a well-known source of illusion. A whirling burning stick or a Catherine-wheel gives the eye the sensation of a continuous wheel of fire; and this is the foundation of the thaumatrope, the successive images of which are made to differ slightly, so that the figure, instead of remaining stationary, moves or seems to move. Thus horses gallop, a juggler tosses balls, &c. To get this illusion the images (each represented at a stage of the action in advance of its predecessor) must be viewed separately and in rapid succession, matters being so arranged that each is seen in the same position that the last occupied the moment before. This may be contrived by the train of images being made to pass behind a screen in which is a slit, showing only the image passing it at the moment, or in other ways. See THAUMATROPE.

Passing now to purely mental illusions of the eye we reach some of the most interesting phenomena. There are the innumerable tricks of the conjuror, where the "quickness of the hand deceives the eye," and the eye is made to think it sees the motion completed which the conjuror has cleverly stopped in mid-career. But what concern us here are the studies of the philosopher, where the eye is made to deceive itself, and the deception is consequently more difficult to unravel. Let some one whirl a ball at the end of a string, and let the observer stand so that the plane of rotation is aslant, and the figure seen is a narrow ellipse; he cannot tell which way the ball is travelling. Or let him look at the sails of a windmill in rotation, edgeways, from about a quarter of a mile, and he may make them go (in his mind) which way he pleases. The illusion arises from the near and far points of the circle being so close, by perspective, that the eye is readily deceived as to which is nearer. If one eye can be made to see a different object from the other eye, as by a tube cutting off rays of light, &c., many extraordinary effects, such as that of seeing through solid objects, may be obtained. For instance, take a piece of paper a foot long and roll it into a tube (or take a tube of that length), hold the tube in the right hand near the bottom, and look down it with the right eye, letting the tube slant somewhat from the eye towards the right side. Now place the open left hand above the right, palm uppermost, lying horizontally, the inner edge (little-finger edge) touching the left side of the tube, and look at the open hand with the left eye, both eyes being open, but the right eye able only to see down the tube. A large hole will appear to be bored through the left hand.

The mental effects of crooked lines, or of interruptions of lines, are very curious. A few out of a very large number are given in the Plate illustrating this article. Thus let C (fig. 1) be a post in front of a transverse diagonal line, *a* will seem parallel with *b*, instead of (as it is) part of the same straight line. Further, C will seem to be nearer to the eye than *a b*. Let both C and *a b* slant and the illusion vanishes. A practical illustration of this may be seen by observing the effect of a plank placed in front of an arch, as in fig. 4. The explanation in both these cases is that the eye does not allow enough for the width of the interposed strip, because that is felt to appear nearer the eye (falsely so in the first case), and the eye allows for the assumed greater visual angle thus intercepted, and rushes upon a false correction of this. The same false correction for visual angle is very evident in fig. 11, where the left-hand circle is unhesitatingly pronounced at first sight to be the larger. Next, let A (fig. 3) be a bar lying across a semicircle, the ends *b c* will assuredly refuse (in the mind) to form part of the same circle as the ends *d e*. Another explanation is that the mind, following the slope of the interrupted line, or the curve of the broken circle, is carried away to the right and left by the obstacle extending in those directions, and that when it returns to its first career and proposes to continue where it left off, it is confused at finding that the curve or the slant has meanwhile progressed. This view is well borne out by another series of illusions, showing the inability of the eye to keep the path of truth amidst temptation. It is easily drawn aside. For instance, let *a b c d*, fig. 2, be a square lying within concentric circles, *e f g h* a square lying upon them: the first will appear to have concave sides, the second convex. Similarly in fig. 5 the really parallel lines seem to bulge and draw apart in the middle, while in fig. 6 they seem to

contract and draw together in the middle. The eye strains after a non-existent symmetry. In fig. 5 it tries to get a pair of double concave outlines, and in fig. 6 a pair of double convex ones. The parallel lines *a b c d e f g* in fig. 7 appear alternately to diverge and converge through the attraction exercised upon the eye by the zigzags, which induce the eye to see the vertical lines not as perpendicular to the base of the figure, but as inclined towards perpendicularity to the zigzags. So also the effort of the eye after a false symmetry will make the sides of the square tend to bulge in fig. 8, and to fall in in fig. 9. At the same time if the square be taken as the starting-point, and the eye forced to acknowledge it as correct, the circle will at once seem to be flattened at the points where it touches the angles of the square; and the converse illusion is produced if the square extend beyond the circle, as in fig. 10, the intercepted arcs now appearing to bulge considerably. The larger the figures are drawn the more perfect the illusion becomes. Representations of crystals in outline frequently present very puzzling effects; thus the letter A in fig. 12 will appear to be placed now upon the uppermost side, now upon the outside of the nearest end, and now upon the inside of the furthest end in turns. The figure turns itself inside out as we look at it. The thick slanting line runs alternately up to us or down from us. So it is that after long looking at a well-drawn arabesque we are hard put to it to say whether it is a white figure on a black ground or a black figure on a white ground. But to attempt to exhaust the illusions of the eye is absurd. We have said nothing of the illusions depending upon the *critical angle* at which total, or nearly total, reflection of light is produced from the surfaces of transparent media (the most famous of which is Pepper's ghost illusion), nor of the kindred phenomenon of the MIRAGE. The limits of such an article as the present are already exceeded. It may fitly conclude with a question, for the fascinating subject is without an end: "By how much is the vertical line in fig. 15 longer than that in fig. 14?"

ILLYR'IA, formerly a kingdom and province of the Austrian Empire, now divided into the districts Carinthia, Carniola, and the Littoral or Küstenland (Coast Land). It was founded by a decree of Napoleon in 1809, and remained as a kingdom till the present arrangement into three provinces was adopted in 1849.

Face of the Country.—Illyria is on the whole a mountainous country, but the coasts are partly low and sandy and partly marshy, especially towards the west. On the west the Bay of Trieste, and on the east that of Quarnero, run deep into the land and form the peninsula of Istria, the extreme point of which is Capo Promontore. In Villach and Clagenfurt the soil is good and the valleys are in general fertile; but a great portion of the surface is rocky and so high that the temperature is unfavourable to vegetation. Neustadtl, Adelsberg, and Laybach consist of rock, marshes, and sandy flats, and are unfruitful. The coast has a dry limestone soil, and in many parts suffers from a scarcity of water, but the vegetation is very luxuriant. Three great chains of mountains, the Noric Alps in the north, the Julian and Carnic Alps in the centre and south, traverse the kingdom from west to east. All the mountains belonging to the chain of the Julian Alps are composed of primitive limestone, and are remarkable for the number of stalactitic caves they contain. The principal rivers are—the Drave, which is navigable, and flows for 120 miles through Villach and Clagenfurt; the Save, which becomes navigable at Laybach; the Quieto, which enters the Adriatic through the harbour of Città-Nuova; and the Isonzo, which rises in Mount Terglou (9300 feet high), the point of junction of the Carnic and the Julian Alps, and flowing south enters the Gulf of Trieste, having received the Torre on the right, the Idria and the Wipbach on the left bank; a few miles before reaching the gulf it divides into two branches, called the Isonzato and the Sdobba, which afterwards unite, inclosing between them the island of Morosina. The course of the Isonzo is important as having once formed the eastern limit of Italy towards Austria. Of the numerous lakes, the largest are—the Lake of Clagenfurt, 11 or 12 miles long, but narrow; the Ossiach Lake, 7 miles long; and the Mühlställer Lake, 8½ miles long, and from 2 to 3½ miles wide. This is the deepest and most beautiful lake in Carinthia, and the surrounding scenery is highly picturesque.

The most remarkable lake in Carniola is that of Zirknitz, about 3 miles long and 2 wide, of which many wonderful stories are told, all originating in the fact that it is sometimes quite full and at others dried up or considerably reduced in size, and this without any regularity or regard to the season of the year; sometimes it does not dry up for years together. This peculiar phenomenon is apparently dependent upon subterranean cavities. Carinthia is much more abundant in mineral waters than Carniola, but there are none that enjoy any remarkable celebrity.

Climate.—The climate of course varies in different parts. The lofty mountains, covered with snow, which either never melts or only in the height of summer, cause the air to be rather sharp and raw in Villach and Clagenfurt; the vine does not thrive here. Though there are some persons afflicted with goitre, the climate is on the whole healthy. It is much milder in Laybach, Adelsberg, and Neustadtl, where the vine, chestnut, and maize flourish. Trieste has a hot climate; the vegetation is luxuriant, but there is a deficiency of water. In the western parts of the coast the air is rendered unhealthy by the exhalations from the lagoons.

Products.—Illyria abounds in mineral wealth. Besides quicksilver it has copper of the finest quality, and yields excellent iron, lead, silver, cinnabar, alum, coals, marble, rock-crystal, porphyry, jasper, garnets, &c.

The vegetable products contain many rare alpine plants, medicinal herbs, and roots; also wheat, rye, barley, oats, maize, buckwheat, potatoes, pulse, some flax, hemp, and hops, garden vegetables, and fruit. The forests have been much thinned for the use of the iron-works, but there is still an abundance of pine, oak, and other timber. The horned cattle and the horses are in general small. The largest flocks of sheep are in the islands, especially in Veglia, which has likewise many horses. Swine and poultry abound everywhere. Of wild animals there are stags, deer, wild boars, chamois, foxes, &c. Bears and wolves are rare. The game consists of pheasants, bustards, partridges, snipes, and waterfowl. The tunny, mackerel, and anchovy fisheries on the Adriatic are very important. The most important manufactures are those of various articles in iron and steel. The commerce consists chiefly of the transit trade between Vienna and Trieste.

Ancient Illyria comprehended all the provinces on the east coast of the Adriatic, with the adjacent islands as far as Epirus, and was inhabited by a people called by the general name of the Illyric nations. Illyria also extended into the interior as far as the Ister (Danube) and the Alps, which lie between Italy and Germany. Macedonia formed the eastern boundary. Owing to the fierce and warlike character of the Illyrians they were longer in being influenced by the civilization of the Grecian colonies than the neighbouring nations. During the early times of the Macedonian kingdom, its existence was frequently endangered by their attacks, especially when they became united under one leader, named Bardylis, in 383 B.C., but they were finally defeated by Philip of Macedonia. Rather more than 100 years later, owing to their piratical attacks upon the Grecian shores, the Romans interfered, and in 168 B.C. became masters of the country; during the empire many of those who attained to the purple were natives of Illyria. On the decline of the Roman power

the Illyrian provinces suffered under the full violence of the barbarian inroads, and the Slavs and Huns ultimately occupied a large part of the country.

IL'MENITE, MENAC'CANITE, or **TITAN'IC IRON ORE** is an oxide of iron and titanium. It occurs in small quantities in many crystalline rocks and in many iron ores, but the titanic acid affects injuriously the iron smelted from such ores. This mineral occurs most usually massive, but large tubular crystals of the hexagonal system are often found. The hardness is 5 to 6, and specific gravity 4·5 to 5.

IL'MINSTER, a market-town of England, in the county of Somerset, 175 miles from London, is in a low but pleasant situation, about a mile distant from the river Ile, whence it derives its name. It consists principally of two streets forming a cross. The houses are neat and well built. The church is a large and ancient cruciform building, with a central tower of light and peculiar construction. The free grammar-school was founded by Edward VI. in 1550, and is very liberally endowed. The population in 1881 was 3281.

IL'VAITE (from the Latin name of Elba, where the mineral is found) is a hydrated silicate of iron and lime. It occurs in striated rhombic prisms, also massive and compact. It has a hardness of 5·5 to 6, and specific gravity of 4. The colour is black or brownish-black, and the lustre submetallic. This mineral is also known as *yenite* and *lievrite;* it occurs chiefly in Elba and the Tyrol.

IMABEN'ZILE is obtained by the action of ammonia on benzile. It is a white crystalline powder, melting at 140° C. (284° Fahr.) It is insoluble in alcohol and ether, but dissolves in sulphuric acid. The formula is $C_{14}H_{11}NO$.

IMAGE WORSHIP. The practice of using images, under which term we include all representations of sacred persons, or symbols, whether carved or painted, in connection with the worship of the Christian church, has been the subject of earnest controversy from a very early period until the present day. It has been the subject of much ecclesiastical legislation at different periods, and since the Reformation the lawfulness of the practice has been one of the stock subjects of dispute between Roman Catholics and Protestants. In the present notice a brief outline of the history of the practice is all that will be attempted.

It is generally admitted that no indication can be found in the New Testament or in the writings of the first age of Christianity of the use of any picture or symbol in worship, and one of the accusations commonly made against Christians was that they set up no image or form of any god. The use of pictorial representations of sacred things, however, appears to have been introduced by the end of the second century, for Tertullian refers to the fact of a representation of Christ as the Good Shepherd being engraved upon the cup used in the communion. The next step was the representation of figures partly historical and partly symbolical, and the tombs of the Christians and the places used for worship in the catacombs of Rome are found to be carved with representations of scenes taken from Scripture history, as well as with the sacred symbols of the dove, fish, ship, lamb, &c. During the fourth century the practice increased in extent, and it became common to cover the walls of churches with pictures of sacred scenes; and in the fifth century statues of Christ, the Virgin Mary, and of the saints seem to have been set up. As may be readily imagined, the introduction of sacred images among people but recently or only partially converted from paganism, soon gave rise to practices of superstition, and hence many men eminent for piety and learning protested against their use, and in the sixth century Bishop Serenus of Marseilles ordered the destruction of all sacred images in his diocese.

This called forth the famous letters of Pope Gregory I., in which that pontiff points out the difference between the use of an image or picture for purposes of instruction and the rendering to it improper adoration. "It is one thing to worship a picture, and another to learn from a picture that which ought to be worshipped. . . . They who are unlearned may at least read on the walls by seeing there what they cannot read in books. . . . If anyone desires to make images do not prevent him, but by all means prevent the worship of images."

During the eighth century the controversy between the Iconoclasts [see ICONOCLASM], headed by the Emperors Leo the Isaurian and Constantine Copronymus, and the general mass of the people led by the monks, assumed great dimensions, and the struggle lasted over sixty years. It was terminated by the decision of the Second Council of Nice (Nicæa), in 787, which decided in favour of the use of images, and distinguished as to the degree of worship by which they might be honoured. It was forbidden to render to them the supreme worship due only to God and termed *latreia*, but it was declared lawful to offer an inferior kind of worship, that of salutations and reverent prostrations, termed *douleia.* A distinction was also drawn between absolute worship, *i.e.* that which is directly rendered to a person himself, and relative worship, which passes through one person or thing to another. The worship of images was held to be relative worship, the adoration paid to the image passing through it to the person represented by it.

The doctrine thus formulated has been substantially sustained ever since by the Greek and Latin Churches, but the controversy was renewed at the time of the Reformation. Luther, while condemning the worship of images, yet refused to forbid the use of them in churches, declaring that people might have them or not as they pleased, they were among the indifferent things concerning which liberty was to be permitted. Hence in the Lutheran churches pictures, crucifixes, &c., are usual ornaments. The Calvinists, on the other hand, entirely repudiated the use of images, condemned the practice as idolatrous, and declared, and still maintain to this day, that they are not to be tolerated in churches. On the part of the Roman Catholics of the Reformation era the Council of Trent confirmed the use of pictures and statues in the churches and for private devotion, maintained the usefulness of the practice, especially for such as were ignorant and unlearned, and renewed the distinction of the Second Council of Nice as to absolute and relative worship. There are still some points, however, in connection with the adoration of images upon which Roman Catholic theologians differ, and it can hardly be disputed that the uneducated members of that church in many places on the Continent invest certain images with a degree of sanctity and miraculous power which goes far beyond the limits defined by authority.

In the Presbyterian and the great majority of the Protestant churches, the use of images and pictures in worship remains quite unknown, and most Protestant divines have condemned the practice as being opposed to the spirituality of the Christian religion. In the Anglican Church the Ritualists have made some efforts of late years to introduce pictures, statues, crosses, and crucifixes in the churches, but the practice is still a subject of controversy, legally and theologically.

IMAGINARY or **IMPOSSIBLE QUANTITIES** are of not unfrequent occurrence in algebra and the higher geometry. To a certain extent all negative quantities are imaginary, for it is in no ordinary or natural sense that we can speak of -3, that is, of 3 *less than nothing*, or of $-a$, that is, of a less than nothing. Yet in practice this use of negative quantities is found to give great facilities, and indeed is capable of fair explanation.

Not so with such quantities as the root of a negative quantity if the index is even. Thus the square root of -8 is quite impossible, for any positive quantity multiplied

plied into itself will give a positive result, while by the rules governing negative quantities the like applies to the multiplication of negative quantities. But as multiplication of positive quantities by negative quantities, or *vice versâ*, would yield a result with a negative sign, the cube root of -8 is by no means an impossible quantity. It is in fact -2. The usual way of dealing with such quantities is to state them in some other and more workable manner. Thus—

$$\sqrt{-8} = \sqrt{4} \times \sqrt{-2} = 2\sqrt{-2};$$

and this possibly may prove useful. In no case, of course, could the impossible quantity be reduced entirely. A distinction is drawn between impossible and *irrational* quantities. For the latter see SURDS.

IMAGINA'TION denotes in its widest sense that faculty of the mind by which it produces at will thoughts or ideas as materials for every other mode of the mental activity. It is not the mere reproduction of memory, but a plastic power constructing new combinations. In its highest form its end or aim is the satisfying of the craving for æsthetic emotion, which may therefore be considered as the basis of fine art, and as the logical opposite of works of utility. There is no bar, however, to the union of the two, as in the finest kinds of architecture. In connection with poetry the term is often employed in a narrow acceptation as synonymous with fancy, which properly is only a particular species of imagination dealing with creations of whim and humour the furthest removed from nature, fact, or reality: such as the pictures of fairyland. Fancy plays on the surface and delights the wit; imagination dives deep into hidden meanings and satisfies the soul. Still narrower is the faculty of literary imagination according to the definition of Dr. Reid, who confines it to a lively conception of the objects of sight, and makes imagination differ from conception only as a part from the whole. And similarly Addison teaches, that "the pleasures of imagination are such as arise from visible objects, since it is the sense of sight that furnishes the imagination with its ideas." But all such endeavours to limit the use of the term are illogical and futile.

In considering imagination the *constructive imagination* claims our first attention. To a so-called unimaginative person the act of constructive imagination is the most wonderful thing in nature; for it seems pure creation. That a seed shall produce a flower, given the suitable surroundings, is not nearly so wonderful to him, because he beholds and touches the seed and the soil, and himself, it may be, supplies water, light, and warmth in due quantity. But the sight of Sir Walter Scott's hand when writing acted upon Menzies, as we are told in the memoir of Scott by Lockhart, in so distressing a manner that he had to shift his seat at dinner to avoid it. Scott was then writing novels in an Edinburgh lodging, and the young men could see into his room. "That hand fascinates me," said Menzies to Lockhart, "it never stops; page after page is finished and thrown on that heap of MS., and still it goes on unwearied—and so it will be till candles are brought in, and God knows how long after that." Scott wrote the two last volumes of "Waverley" in the evenings of three summer weeks. Handel composed the opera of "Rinaldo" faster than the poet could write the verses for him, and completed the whole "Messiah" in twenty-four days. Of another musician of the very highest rank, Mozart, we know by his own testimony that, having selected his themes, he simply lay and listened to an imaginary orchestra which played them and developed them; afterwards, with that marvellous memory quite phenomenal in him, writing down what he had heard. That is his simple report. Beaumarchais also has related (only that one is not quite so sure of Beaumarchais as a witness) that in writing his masterpiece, the "Barber of Seville," he kept crying out, "Take care, or you will be seen!" "Quick, hide the letter!" and so on; and as the imaginary persons in whose fate he was interested behaved, obeying or disregarding his warnings, so did he write down their acts and speeches. The list of illustrations might be indefinitely extended. But what is a mystery to the creators themselves almost as much as to those whom they enthral with their creations, is, when patiently tracked out by the psychologist, only the parallel of the germinating seed after all; of the two, indeed, it is less mysterious. And, as will appear, even the most prosaic people are constantly in the habit of creating ideas by their imagination, although they do not recognize the kinship of their humble productions with the glorious fancies of Shakspeare or the inspirations of Stephenson or Newton.

Every sensation or feeling leaves a certain afterglow in the mind; that is to say, after it has passed away it remains for a short time in IDEA. By the long-continued practice of men for countless generations this ideal side of mind has been cultivated, and an image once received upon the mind is readily induced to persist. Further, by a well-known law of the mind, the law of contiguity, two things happening together in time, or two things resembling one another, tend to persist as a group in the mind. (We have thus two forms of this grouping—the association of ideas by contiguity, and the perception of similarity amid diversity.) Hence one of such a grouped pair, if seen, will easily call up the other in idea. If an infant sees a feeding bottle every time its hunger is allayed, it very quickly cries for food when it catches sight of the bottle, for the present image of the one suggests the idea of the other even to its extremely feeble mind. Older minds acquire not only grouped pairs, but larger and indeed intensely complicated aggregates of numerous sensations, so that the slightest stimulus is sufficient to call up in idea vast trains of past impressions, each link of the series suggesting the next, and the nerve force (if a figure is allowable) travelling as surely and as swiftly along the well-accustomed channels as an express train along its rails when once the master-hand has started it. Macaulay could quote page after page; Von Bulow could play the entire compositions of more than one composer; crowds of instances nearly as startling abound on every side. This is what we call *memory*. The occurrences, now ideal, have been actual; the brain resembles the store-room of a photographer, crammed with pictures taken day by day, and any of these past pictures able to be referred to. Only these pictures will never be quite so sharp nor so defined as nature herself; while, at the same time, the photographers who take them vary greatly in skill, so that one man's work will last a lifetime and another's will be faded in a few months into a condition scarcely recognizable.

Now, having this storehouse of ideal images of past actual sensations and feelings, we have to account for the creation of sensations and feelings which never existed, and possibly never may exist. The roots of this extraordinary power of the mind, shared in by practically all men, but possessed in its highest form by the fewest of the few, are twofold.

The first manner in which the possessions of memory are transformed into the creations of imagination is by selection, the second by addition. The two commonly work together. A certain mental image presented to the mind by memory is deprived of many of its features, and other features are added instead of them, culled from other mental images. To take a well-known example:—Mrs. Pendennis was in many respects modelled closely on the characteristics of the mother of her creator, Thackeray; but (apart from her position in the story of "Pendennis") the character is distinguished from a literally faithful transcript from nature by some added traits from other ladies of the novelist's acquaintance. A more striking illustration is the character of Horace Skimpole in the

"Bleak House" of Charles Dickens, whose personal peculiarities are little more than a direct copy of those of the eminent literary man and poet Leigh Hunt, while his moral character is as unlike Mr. Hunt's as an unfeeling scamp is unlike a highly refined gentleman. The fitting of this contemptible soul into Mr. Hunt's body caused, as might be expected, much pain; regretted probably very keenly by the novelist himself. An intentional effort of the same sort is in the painting of Da Vinci of the "Last Supper," where the painter has avenged himself for much provocation received at the hands of the subprior of the convent, by putting his head upon Judas' shoulders, left headless until the last moment for want of a suitable countenance.

Here we see how dependent is the artist, however creative he may be, upon materials actually stored in his brain. He constructs, but the bricks are only those with which he is previously supplied. Careful research traces out every idea to some absolute fact, the combinations alone are new. His sense of artistic effect enables him to select the suitable fragments from many effects of memory, and play with their combinations—accepting some, rejecting others. No doubt Mozart's orchestra (in the foregoing illustration) was requested to play over some parts of its work several times in the musician's brain, and the more exquisitely appropriate harmonies were alone selected for preservation.

But the imagination is not a merely artistic faculty. It is the tool of the scientific man, of the student, of the inventor, equally with the poet or the painter. Watt noticing the steam rocking the kettle lid, in imagination pictured this motive power as turned to account; Newton seeing the apple fall, perceived in imagination that perpetual fall of the moon towards the earth which converts the straight line of unimpeded motion into a nearly circular orbit. In each case an actual fact has its essential elements extracted, and aided by quite distinct facts culled from memory becomes the basis of an entirely new combinational idea. In fact the function of imagination in science is enormously weighty; it is impossible to overrate it. At the present time the entire theory of light, as accepted by all the highest professors, is a pure effort of the imagination. We are told to imagine a substance without weight, without visible form or colour, without resistance, so extended as to reach the furthest stars, and yet so firm as to transmit the almost inconceivably rapid waves of light. Anyone hearing of such a substance for the first time, would think its description a very poor and absurd joke; and yet this is the *ether* which the imagination of scientists has invented to assist in carrying out their theories. It is highly improbable that it can have any existence; meanwhile it exists in imagination and serves a very useful purpose. This is only one instance; the conceptions of chemistry and electricity, the molecular theory, and many more equally useful, equally unprovable, efforts of the scientific imagination occur to anyone who devotes a passing thought to the subject. In the practical arts both of war and peace it is equally potent: all men are the servants of the master who possesses it. Napoleon used to say that the greatest generalship lay in estimating where the unforeseen was most likely to show itself; for he assumed that a true captain would include a certain proportion of chance in his otherwise perfected plans. The man of commerce whose sense of proportion enables him almost by instinct to eliminate the improbable elements from those imaginative forecasts of his trade which he is perpetually making, is the successful man, the man who will win in the race for wealth.

We have, however, to go into the ordinary life of every man to find the humblest and commonest use of the creative imagination; and here we quickly see, when we look for it, that the commonest reckoning of probabilities involves a true use of the imagination, simple though it be. The man who saves money for his old age, who makes plans for what his baby-boy is to do when he has in his turn reached manhood, nay even the man who burdens himself in bright sunshine with a thick coat because he may possibly remain out until the chilly night comes on, each one of these in realizing a future which very likely may never come to pass is in truth as really exercising the constructive power of imagination, though only in his humble way, as the subtlest thinker of original thoughts in his high degree.

There is another and quite distinct office of imagination to the active constructive work which has been dealt with above. This is that department of imagination which may be called the *passive* side. It is so easily recognized as hardly to need more than mention. The expression *receptive* or *passive imagination* serves to denote that exercise of imagination which every reader, or hearer, or learner is bound to use in order to follow the constructions of the creative imagination set before him. He has in his turn to create indeed; but then the pattern is given him, and by the help of the facts of his own memory he fills out as best he may; in the cases treated of above this pattern is non-existent, the creative artist has himself to make it. The difference is immeasurably great, but is one of degree, not of kind. A native of equatorial lands might be made to comprehend the term *ice*, even if he were never to see the substance, but it would only be by the passive use of the imagination. His instructor would lead him on through the experience of such cold as was attainable to a conception of one of its qualities, through the contemplation of glass to another, and so on. Thus combining parts of known images the desired unknown might be attained with tolerable certainty.

To the beneficent use of the imagination there is a stern limit. Those who recklessly cut away the common-place, sober, every-day elements of the ideas with which memory presents them construct for themselves a fool's paradise. These are the inveterate schemers, or the novel readers, or the spinners of metaphysical cobwebs, dwellers in an unwholesome half light. The constructions of the imagination are an excellent superstructure on a basis of fact; but used as a basis themselves they are foredoomed to failure. Thus the earlier Greeks, most fertile of people in imagination, hit upon hypothesis after hypothesis in natural science; but as they never proceeded to verification they did not benefit the world by a single advance in scientific knowledge. The abuse of the imagination is in fact a wicked waste; an excellent servant, it is of all masters the most cruelly tyrannical. On the particular character of the imagination depends much of the happiness or misery of the individual. Acting upon human hopes and fears, it assumes the name of sensibility, and by the bright or sombre images with which it fills the distant prospect of life, it affords a double relish to every enjoyment, or gives a keener edge to sorrow and misfortune.

IMA'GO is a name given by Linnæus to the third or perfect state of insects, when they appear in their proper shape and colours, and undergo no further transformation. Many insects seem only to attain the perfect condition in order to fulfil the duty of reproducing their species, which done they die.

IMASA'TIN is obtained by boiling together isatin and ammonia. It is a greenish-yellow crystalline substance, insoluble in water and ether, but soluble in boiling alcohol and also in caustic potash. The formula is $C_{16}H_{11}N_3O_3$. Dichlorimasatin ($C_{16}H_9Cl_2N_3O_3$) and tetrabromimasatin ($C_{16}H_7Br_4N_3O_3$) are the chlorine and bromine derivatives of this body.

IMAUM' or **IMAM'** (Arab., teacher), the title or designation of a Mohammedan minister, whose duties correspond to those of a Christian priest, in that he attends at circumcisions, marriages, and funerals, has charge of the sacred buildings, conducts the services, and preaches there. He is distinguished from the laity by the avoidance of

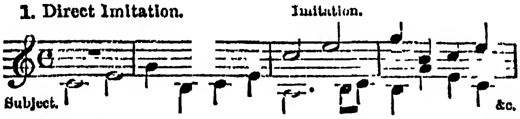
bright colours in his dress and in that he wears a white turban. Sometimes the imaum combines a secular calling with his ministerial duties, for though the office is held in high respect the stipend attached to it is often scanty. The title has always been held by the caliphs or successors of Mohammed, and the Sultan of Turkey is entitled *the* Imaum, as being the spiritual head of the Mohammedans.

The twelve "blessed imaums," according to the Persian creed, are Ali, Hassan, Hussein, and the latter's lineal descendants to the ninth generation (and therefore the descendants of Mohammed himself). Without arms, or treasures, or subjects these imaums successively enjoyed the veneration of the people and provoked the jealousy of the reigning caliphs, and their tombs are objects of worship to this day. After the murder of Hussein [see HASSAN AND HUSSEIN] his successors saw it was hopeless to struggle against brute force, and they abandoned political for spiritual power. The last of the twelve was so worshipped as to gain the appellation of *Mahdi* (the Guide). He habitually sought to conceal himself, in his great humility, from those who came to worship him. At last his followers lost him altogether, but the belief was universal that he was still alive, and would reappear towards the end of the world to overthrow the reign of Antichrist. A person calling himself the Mahdi caused much trouble in Egypt in 1884–85.

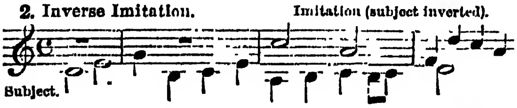
IMITA'TION, a very important element of the higher branches of musical composition. It consists essentially, as its name imports, in the imitation, or repetition with certain allowed differences, of a musical phrase already heard, which is called the *subject*.

Imitation has six varieties, which are exemplified below, the first, fifth, and sixth alone being in common use, and the first being what is meant by the term imitation as ordinarily employed without qualification:—

1. Direct Imitation. Imitation.



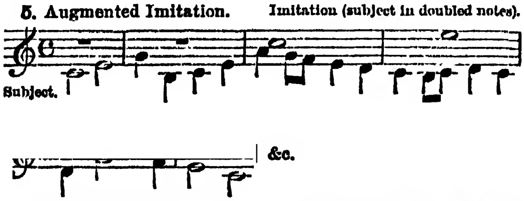
2. Inverse Imitation. Imitation (subject inverted).



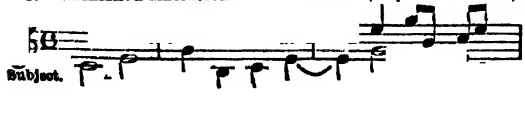
3. Retrograde Imitation. Imitation (subject read backwards).

4. Retrograde Imitation. Im. (subject backwards and inverted).

5. Augmented Imitation. Imitation (subject in doubled notes).



6. Diminished Imitation. Imitation (subject in half notes).

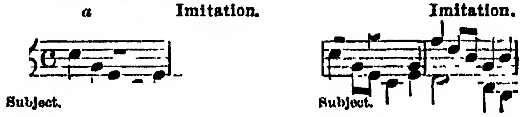


Imitation is further divided into *strict* and *free*, which vary with the closeness with which the intervals of the subject are followed by those of the imitation. All the imitations of the examples above are *strict*.

Imitations may be taken (as in the above examples) *after* the subject, or upon it; the latter is of course the more artificial and interesting manner, and in the *stretto* of a FUGUE it is, as elsewhere shown, indispensable.

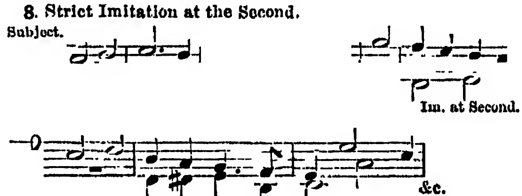
Very great latitude, except in fugue and canon, is allowed to the free imitations of subjects. The figure of the subject is never altered. Rather the general effect of a passage than its exact intervals are sought to be reproduced; thus the following examples, *a* and *b*, would be held good specimens of free imitation, though in the latter a Fourth is answered by a Seventh. This is of course an extreme case.

7. Free Imitation (Direct).
a Imitation. Imitation.



In composing pieces in imitation the subject is chosen for easy recognition; it is sufficiently striking in figure, not too wide in range nor too long; and when it has been heard in one part or voice, that part or voice continues with a suitable accompanying counterpoint, as in all the examples given above. The imitation can be given at any interval from the subject desired; the easiest being the octave, the most difficult the second or the seventh. The following is a specimen of imitation at the second:—

8. Strict Imitation at the Second.



If the imitation is to be upon the subject, only that part of the subject before the imitation begins is to be first composed; then the beginning of the subject being written in the imitating voice as it occurs, the subject is to be continued and completed as a counterpoint against it; of course double (or invertible) counterpoint is much preferable in this case.

IMMACULATE CONCEPTION. The doctrine that the Virgin Mary, in consequence of her being appointed to be the mother of Christ, was preserved free from the taint of original sin, seems to have been known in the church previously to the ninth century. It was held merely as a pious opinion, however, and the first authentic historical trace of it is to be found in a letter of St. Bernard of Clairvaux, written to the canons of the cathedral at Lyons in 1140. The latter had, without consulting the Roman see, introduced a festival in celebration of the doctrine, which St. Bernard condemned as an unauthorized novelty, and in his remonstrance he rejects the doctrine also as unscriptural. In place of this doctrine he contends for the sanctification of the Virgin while in her mother's womb, as the prophet Jeremiah was sanctified (Jer. i. 5), and also St. John the Baptist (Luke i. 15). The manner in which the letter of St. Bernard was received by those to whom it was sent is unknown, but it formed the commencement of a series of controversial writings on the subject by which the church was agitated until the middle of the present century. In the beginning of the fourteenth century the doctrine formed one of the chief themes of controversy between the Thomists or followers of Thomas

Aquinas, and the Scotists, who supported the teaching of Duns Scotus. Aquinas on this subject supported the doctrine of St. Bernard, and in this he was followed by his order, the Dominicans; while Scotus, who maintained the extreme view of the immaculate conception, was followed by his order, the Franciscans, and it is upon this point that the prolonged controversy between these two great orders has chiefly turned. So high did the tide of conflict run during the fifteenth century that Pope Sixtus IV. published two bulls (1477–83) threatening with excommunication all on either side who charged their opponents with heresy, inasmuch as the point had not been authoritatively decided by the Roman see.

The Council of Trent came to no decision on the subject, but it added to its decree concerning original sin a clause to the effect that it "did not comprehend the blessed and immaculate Virgin Mary," and confirmed the constitutions of Sixtus IV. The doctrine gradually grew in favour during the subsequent period, and numerous attempts were made to obtain for it authoritative sanction. A limitation was put upon controversy in favour of the doctrine by Pope Gregory XV.; additional honour to the festival was granted by subsequent popes, and Gregory XVI. allowed the term immaculate, previously forbidden, to be used in the public service. Finally, in 1849, Pope Pius IX. issued an encyclical letter to the bishops of the Roman Catholic Church calling for an expression of their opinion and that of their people upon this subject, and as to how far the dogmatic definition of the doctrine was desired. The response to this appeal is said to have been almost unanimously in favour of the doctrine, and it was solemnly promulgated in a bull issued 8th December, 1854, which declared that "the most blessed Virgin Mary was, in view of the merits of Jesus Christ the Saviour of the human race, by the singular grace and favour of Almighty God, from the first moment of her conception in the womb of her mother, preserved free from all taint of original sin." In the Roman Catholic Church the festival of the immaculate conception is held on 8th December. In the Anglican Church there is the festival of the conception of the blessed Virgin Mary, held also on 8th December, while in the Greek Church there is a festival in honour of the conception of St. Anne (the mother of Mary), 9th December, but in these churches there is no reference to the special doctrine of the Roman Catholic Church.

IMMORTAL'ITY. The feeling that death is not the end of individual conscious existence, like the conception of a higher and unseen power above man, is one of the deepest and strongest of the instincts of humanity. It appears among the rudest and most primitive peoples, and it has ever formed part of the belief of civilized men. As with the conception of a deity, although absolute universality cannot be claimed for it, the exceptions are so few that they only confirm the rule.

The belief in a continued existence after death formed an important part of the religion of ancient Egypt, and the doctrine received there a high degree of development. The Egyptians believed that the soul at death passed into an unseen world, the hidden country where Osiris ruled and pronounced irreversible judgment. The oldest papyri contain the Egyptian "Book of the Dead," which is supposed to date from the period of the Exodus, and which deals in its latter portion with the judgment of the soul in the Hall of the Two Truths; there are many pictures of this judgment to be found among the tomb paintings that remain. If the soul when weighed in the balances was found worthy of reward it passed into the presence of the gods and entered a state of blessedness, though it was supposed at times to revisit the earth and to have some mysterious interviews with its embalmed body in the tomb. Unworthy souls were condemned to a prolonged period of transmigration of uncertain duration.

Among the Persians also the belief in a future life was firmly established and very considerably developed. The warfare between the opposing principles of good and evil was extended beyond the confines of the world and the limits of the present life, and after death the soul was believed to pass on to a bridge leading to the home of the angels, the righteous passing over in safety, but the wicked falling off into the dark abode of Ahriman. They had also a belief in a final judgment or consummation of all things, and a notion of a future resurrection of all men both good and bad.

The belief of the Hindus on this subject has already been described in the articles BRAHMANISM and BUDDHISM, and it will be sufficient to note in this place, that the widespread doctrine of the *transmigration of souls* always implied a continuance of existence, the happiness or sorrow of which depended upon conduct. In China the belief in the existence of the soul is further illustrated by the very ancient custom of making offerings to the shades of ancestors. It is sometimes represented that the system or teaching of Confucius is opposed to the belief in immortality, but this is hardly correct. The position of Confucius towards that doctrine seems to have been one of agnosticism. Certainly no more than this is implied in his oft-quoted answer to an inquiry on the subject: "While you do not understand this life, how can you understand about death?"

In the early periods of Greek history the soul was believed to pass from the body at death into a world of shades, situated in a distant or lower region of the earth. The visit of Ulysses to this abode is described in the eleventh book of the Odyssey, and its aspect is depicted as one of gloom and sadness. The souls of the departed retain their personality and memory, but the heroes mourn their lost powers, and Achilles, when hailed as a king among the dead, replies that he would prefer to be a slave upon the earth among the living. In the later poetry and philosophy of Greece a higher and more cheerful doctrine is displayed. The souls of the wise and good find a happy and exalted abode in the Isles of the Blest, and the wicked are punished until their sin is expiated and purged away. The belief in immortality was accepted and defended by the chief philosophers both of Greece and Rome, but at the same time there were some who doubted it and others who denied it altogether. The teaching of Socrates on the subject deserves special mention. "Death," he says, "is the happy release of the soul from the body. In this life our highest and purest thoughts are distracted by cares and lusts and diseases inherent in the flesh. He is wisest who keeps himself pure till the hour when the Deity himself is pleased to release him. Then shall the foolishness of the flesh be purged away, and we shall be pure and hold converse with other pure souls, and recognize the pure light everywhere, which is none other than the light of truth. Hence the wise man leaves with joy a world where his higher nature is trammeled by evil and impurity; and his whole life is but a preparation for death, or rather an initiation into the mysteries of the unseen world."

The ideas of the Hebrews upon this subject are surrounded by obscurity so far as the earlier periods of their history are concerned. Notwithstanding their nearness to Egypt and their intercourse with that country, they do not appear to have accepted any of the Egyptian theories as to the future life. The silence of all the earlier of the writings that make up the Old Testament as to this doctrine is so complete that many scholars have declared that previous to the Captivity the Hebrews had no belief in the existence of a future state at all. Certainly the rewards of Jehovah for faithful service are such as pertain to the present life, and no appeal is based upon anything beyond, but there seems at the same time to have been a conception of an independent life for the spirit after death in Sheol. This abode, judging from the references to be found in the

Psalms, prophetical writings, and the Book of Job, seems in many respects to resemble the Hades of the early Greeks. Sheol is a land of darkness, as darkness itself, where slave and master, kings and counsellors, prisoners and oppressors are alike gathered together. It is a place of quiet and rest, but it is inferior to the world of life, and the spirits there are unable to join in the service of Jehovah. [See HADES, HELL.] The extent to which Jewish beliefs were influenced by their contact with Persia cannot at present be estimated with accuracy, but there can be no question that their belief in a future life, as developed in the period subsequent to the captivity, owes very much to the conceptions of the Persians already referred to. In the interval between the Captivity and the birth of Christ the belief in a future state of rewards and punishments became firmly established, and with it there was also a doctrine of a resurrection. Indications of this may be found in the later writings of the Old Testament, as, for instance, in the Book of Daniel, and it is displayed more clearly still in some of the Apocryphal books. At the time of Christ these beliefs were maintained by all except the Sadducees, and the latter, Jose'phus informs us, when they came into office had to conform to the notions of the Pharisees, "because otherwise the multitude would not endure them." The belief in a future life and a future state of rewards and punishments is implied in all the teaching of Christ, and his defence of the doctrine against the arguments of the Sadducees is based upon that part of the Old Testament they professed to accept as authoritative, and is recorded by all three of the Synoptics. It formed one of the chief points in the teaching of the apostles, who pointed to the resurrection of Christ as a triumphant proof of immortality and also of the final resurrection of all men. In the progress as well as in the origin of Christianity the belief in immortality has ever formed one of the chief fundamental doctrines; indeed it forms so essential a portion of its teaching that we cannot conceive of the system apart from it. It touches every other doctrine, and is always implied as a thing of course, when any truth of Christianity is considered. With the numberless developments of the Christian view of this doctrine, and the many various conceptions that have arisen among Christians concerning the conditions of the future life, it is beyond the province of this article to deal.

The belief in a future state forms an important part of the system of Mohammedanism, and though Christian critics have ever alleged that narrowness and sensuality characterize the Mohammedan conception of paradise, there can be no question as to the importance a belief in it has played in the history of the world. In the past it inspired a fierce fanaticism in battle that seemed at one time as if it would carry the crescent around the earth, and that it still retains some of its old power the experiences of the semi-religious war in the Soudan in 1884–85 amply testified.

A belief in a future life has been found to exist among the primitive inhabitants of America, of Asia, of Africa, and among Polynesians, Papuans, and Australians. In most instances it is of a very vague and uncertain character, and is mingled with much that is puerile and superstitious. One of the dark sides of the belief is displayed in Ashantee and Dahomey, where it is the chief incentive to the horrible massacres called customs. By some tribes the existence of a soul and separate life is not confined to man, but animals and even inanimate things are supposed to be similarly endowed.

Among civilized nations at the present day the belief in a future life is accepted by the majority of men. Many who are dissatisfied with the orthodox teachings concerning its details endeavour to sustain a position of agnosticism on the subject, and a few only directly assail it. The dissatisfaction with the present existing evils of society which in most of the nations of Europe finds expression in the systems of Communism, Socialism, Nihilism, &c., in its revolt against civil and ecclesiastical authority, generally assails both the belief in a God and in a future life, and the disbelief in the latter is in some instances avowed with a passionate zeal that borders upon fanaticism. It is tolerably clear, however, that this hostility in reality is not directed against the doctrine from any philosophical grounds, and nothing new has been advanced by any of the leaders of the movements indicated in opposition to it.

So far as the discussion of the matter has been carried on apart from the revelation of Christianity it is generally admitted that up to the present the existence of a future life cannot be demonstrated. Elaborate metaphysical arguments have been advanced in favour of the doctrine, but they have failed to secure conviction from any save such as were already convinced or favourably disposed. On the other hand it is equally certain that no opponent of the doctrine has ever succeeded in proving its impossibility, or that it is in any way improbable or unlikely. Further, many reasons in favour of the belief have been indicated, which, though not logically equal to a demonstration, have yet been sufficient to fully satisfy some of the keenest and most profound thinkers of the world. The peculiar significance of the fact that such a belief is so ancient and widespread, that the hope of immortality is so deeply embedded in the minds of the majority of men, that it is so natural and easy to believe in it, and so difficult or almost impossible (to most men) to disbelieve it, have been adduced as evidences in its favour. It is the belief of scientific men and religious enthusiasts alike that nothing useless or causeless can maintain its existence, and inasmuch as there are and always have been in humanity hopes, powers, and ennobling desires which cannot find satisfaction in this life, it has been argued that their existence implies a life beyond the present. The dignity and exaltation which this doctrine gives to the present life, and its important bearings as an incentive to duty and a comfort in trial and bereavement, if not arguments, are yet very powerful influences in maintaining for it its place in the affections of men, and these are closely bound up with that which forms after all the strongest of the arguments adduced in support of the doctrine—viz. that based upon the conception of God.

Christianity, whatever may have been the ideas of men in other faiths, has maintained the belief in an infinite, all-perfect God as the central truth of religion. It has been felt that there must be attributes in the Divine Being corresponding in some way to the ideas of perfect justice and love sought after in the highest and best moments of human thought and life. It is certain that justice and love do not obtain full sway in the present life; but against the limitations of the present, men have turned to the contemplation of a state beyond, where all wrongs shall be righted, all mysteries explained, and where love shall prevail without limit or end.

IMMOR'TALS, among the ancient Persians, was the title given to a body of 10,000 soldiers who constituted the personal guard of the sovereign, and were always of the same number. The same term was applied to the bodyguard of the Greek emperors, the so-called "Romans" of Constantinople.

IMMU'NITIES OF CLERGY. See BENEFIT OF CLERGY.

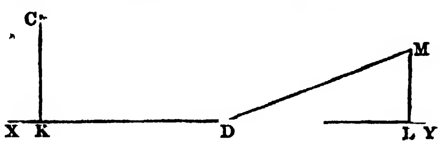
IMP, in Old English, meant a graft or scion, hence an "olive branch" in the sense of *son*. Imps of darkness or Imps of Satan have been phrases so much used that the word has now come to be almost synonymous with demon. It almost raises a smile when we read Thomas Cromwell's inquiries of Henry VIII. after "that noble imp, your son," and the form of prayer drawn up at that time is still worse, since it urges men to pray for "his Majesty and for his beloved son Edward, our prince, that most angelic imp."

IM'PACT (Lat. *in* and *pactum*) and **COLLISION** are the technical terms used in mechanics for the meeting of bodies in motion. It is usual to treat the first principles of this subject by supposing the bodies in question to be spherical; because, theoretically, if spheres of equal magnitudes could be made to strike one another on a plane in the direction of a line joining their centres of gravity, without friction on the plane, a motion simply of translation, without any rotatory motion, will take place. The conclusions deduced from the impact of such spheres, of equal or different weights, will hold good for bodies of any other form, provided there be no rotation and the line joining their centres of gravity pass through the point of contact.

The consequence of friction taking place (and in actual experiment it invariably does take place) between the balls and the plane is that the former acquire a rolling motion on the latter; and to this circumstance is owing many of the phenomena observed in games of billiards.

Suppose a ball A to be impelled directly towards an immovable obstacle, such as an upright ledge at the end of the table. On striking this ledge the ball will, generally speaking, recoil. Some substances will hardly give any recoil, while others will send the ball back with nearly the same velocity as that of its approach. At the moment of impact, the ball and obstacle compress one another, and the pressure continues until the reaction has destroyed all the velocity of the ball. If, then, there were no effort in the parts of the obstacle, nor in those of the ball, to recover their former position, the ball would remain at rest close to the obstacle. If the recoil were complete, that is, if the parts of both bodies endeavoured to recover their position with a force equal to that which disturbed them, the recoil would rapidly but gradually [see IMPULSE] create in the ball a velocity equal to that with which it approached. In the first case the bodies are said to be wholly inelastic, and in the second (which exist only in imagination) the elasticity is said to be perfect. But if only a fraction, e, of the velocity of approach be restored, then e is said to be the measure of the elasticity of the bodies. Perfect elasticity is usually represented by unity.

Suppose the ball A (which is so small that its size may be neglected) to approach obliquely towards the obstacles



X Y, say in the direction C D. Let C D be the velocity or length moved over in one second. Then by the parallelogram of forces the velocity C D is equivalent to the two velocities C K and K D. The first is destroyed and then partially restored by the impact; the second remains unaltered, except by the friction at the moment of impact, which we do not consider. If, then, we take D L equal to K D, and draw L M perpendicular to X Y, and in length such a fraction of K C as e is of 1, the ball will move, after impact, with the velocities D L and L M, that is, with the velocity D M in the direction D M. If the system were perfectly inelastic, the ball would proceed along D L; if perfectly elastic, M L would be equal to C K, and D M and C D equally inclined to X Y. If the size of the ball be taken into account, X Y must be supposed to be a line parallel to the obstacle, and distant from it by the radius of the ball. On the same principle may the motions resulting from the oblique impact of two elastic balls be determined.

If two perfectly elastic balls be equal in magnitude, the velocity of each after the impact is that which the other had before the impact, both in magnitude and direction. In all cases perfectly elastic balls recede from each other after impact with the same velocity with which they approached before impact. But in every other case the rate of recess after impact is the same proportion of the rate of approach before impact which e is of 1. The *vis viva* of a couple of perfectly elastic balls is the same before and after impact; in every other case it is less after impact than before.

In every case of impact, when the balls approach one another with uniform velocities, the centre of gravity of the balls moves uniformly and in a straight line. After the impact, though the directions and velocity of the balls may have changed, yet their centre of gravity still continues to describe the same line, and with the same velocity as before. This proposition also is proved in all works on elementary mechanics.

IMPALED, in heraldry, applies to two coats-of-arms arranged side by side in one shield. This is usually done by husband and wife, and by bishops, deans, heads of colleges, and knights-at-arms, who impale their own arms with the insignia of their office.

IMPANA'TION (Lat. *in*, and *panis*, bread) is the Lutheran dogma of the Lord's Supper, wherein it is explained that the body and soul of Jesus are united with the bread and wine by consecration, much as in nature the soul of man is united with his body.

IMPA'TIENS, a genus of plants so called from the sudden and elastic force with which they burst their capsules. Several of the species are well known as highly ornamental annuals by the name of balsam. The common Garden Balsam (*Impatiens Balsamina*) is a native of India, China, and the Malay Archipelago, and was introduced in 1596. It is a very variable plant in habit and size and colour of flower. The varieties are white, rose-coloured, red, purple, and variegated. The Scarlet-flowered Balsam (*Impatiens coccinea*) is a variety with narrower leaves and long slender spur. Another variety, the Horned Balsam (*Impatiens cornuta*), has dusky-green, sweet-smelling leaves, and purple or white flowers, with spur much longer than the flower. The common Touch-me-not (*Impatiens noli-me-tangere*) is a native of Europe and North Asia. It is found, though rarely, in mountainous districts of the British Isles. The valves are so elastic in this as well as other species, that when they are ripe the least touch will cause them to spring open and scatter the seeds to a considerable distance. The whole plant is acrid, and is avoided by animals. It was formerly used as a diuretic and vulnerary, though considered dangerous. There are 135 species of this genus, two natives of North America, three of Europe and North Asia, twenty of Africa or Madagascar, and all the rest of the mountainous parts of Asia. The flowers are irregular, and often handsome. The sepals are coloured; these are normally five in number, of which the posterior is the largest and is spurred, the two anterior are small or are altogether wanting. There are five petals, of which two on each side are joined together. There are five short stamens, the anthers more or less cohering. The ovary is five-celled, and the capsule has five valves.

IMPEACH'MENT is the name given to an accusation brought by the House of Commons and tried before the House of Lords. Theoretically the House of Commons may impeach persons of all ranks in society, and for any kind of crime or misdemeanour, but practically the power is reserved for dealing with persons of high rank and influence who may be charged with any great public offence, such as treason or malversation. The prosecution is conducted by managers appointed by the House of Commons. A royal pardon cannot be pleaded in bar of the prosecution, but after sentence the person found guilty may be reprieved or pardoned like an ordinary convict. The earliest recorded instance of impeachment is that of Lords Neville and Latimer in 1376, and the last instance that of Lord Melville in 1804.

The Commons, in impeachment, are accusers only, and not judges, for the judicial authority of Parliament was declared in 1399 (1 Henry IV.) to lie with the Upper House alone. Should the Commons wish to judge the accused, they must proceed by Bill of Attainder, which passes both Houses and receives the royal assent in the usual manner of Acts of Parliament. In this way Henry VI. and Queen Margaret of Anjou were attainted in 1461. Defence was usually allowed, but the terrible Thomas Cromwell, minister of Henry VIII., urged that this was not necessary, and by a wondrous Nemesis he was himself the first victim of this barbarous innovation (1540). Attainder was not uncommon under the Stuarts in those cases where the Commons feared impeachment would fail from want of evidence or difficulty in procuring it (as with Strafford and Laud). The last attainder was that of Fenwick in 1696, when impeachment was not feasible, as it was a case of high treason, and as one of the only two witnesses available had been got out of the way, two witnesses being by ancient law required for cases of treason. If, however, the evidence be ample impeachment is the constitutional weapon. The Commons bring up their evidence, by their managers, at the bar of the Lords, and the latter pronounce after hearing it, giving a verdict of *guilty* or *not guilty*, but not passing judgment unless the Commons demand it, so that by the option of omitting this demand an indirect power of pardon is given to the Commons.

It is to the "Good Parliament" that we owe the invention of this powerful weapon. In 1376 the Commons impeached Lords Latimer and Neville for extortion and for dealing with the king's debts (the aged and doting Edward III.), and they were fined and banished. Thus was obtained the sacred right of impeaching the king's ministers for conduct prejudicial to the state. The counter part of this doctrine, that ministers are responsible to the nation as well as to the king, was settled by the impeachment of Richard II.'s chancellor, the Earl of Suffolk, in 1386. The Duke of Suffolk, so blamed for the failure of the Hundred Years' War, and the favoured minister of Henry VI., or rather of his queen, was impeached in 1450, confessed and threw himself on the king's mercy, and was exiled for five years. (See Shakspeare's "Henry VI." for a vivid sketch of his assassination as he was going into exile.) Under the Tudors and earlier Stuarts, as has been said, attainder to a large extent replaced impeachment. But in 1621 occurred the most important and famous impeachment of Lord Bacon, who was condemned to imprisonment and to pay £40,000 for accepting bribes. In 1624 Lord Treasurer Middlesex was impeached, and it is owing to his well-founded complaints that ever afterwards impeached persons were allowed to defend themselves by counsel. In 1626 occurred the great struggle over Buckingham. Sir John Eliot carried the bill for his impeachment, on charges of having bought office, &c., but really on the charge of unduly influencing the mind of the king (Charles I.) Charles dissolved Parliament to avert the storm. A clergyman who preached in favour of the king's right to levy taxes, Dr. Mainwaring, was the next person to suffer by impeachment (1628), and on his release from prison the king marked his sense of what had occurred by making him bishop of St. David's. The great impeachments of the Long Parliament, those of the Earl of Strafford (1640) and of Archbishop Laud (1641), began to show signs of weakness as they progressed, and were thrown aside in favour of attainders. So again, after the Restoration, Clarendon was impeached (1667) on the charge of having "designed a standing army to be raised and to govern the kingdom thereby, advised the sale of Dunkirk to the French, and grossly violated the liberty of the subject by illegal imprisonment." This case never was completed, for Clarendon fled to France and died in exile.

Danby's impeachment in 1678 (Osborne, earl of Danby and duke of Leeds) on the charge of high treason, for having written the famous secret letter betraying England to Louis XIV. of France, was of the very highest constitutional importance. For though the letter was endorsed by Charles II. with the words "This letter is writ by my order, C. R.," it was successfully maintained that the royal command does not justify an illegal act. Danby was brought to trial, and though the king pardoned him, he was thrown into the Tower, 1679, the pardon only being valid after judgment. In 1683 he was admitted to bail as the case had not been decided. In 1685, as the accusing Parliament had been dissolved, the Lords declared the impeachment had lapsed, Danby was released, and subsequently rose to honour under William III.

Passing over several impeachments of less note, and the breakdown of the impeachment of the Whig Lords Portland, Oxford, Somers, and Halifax, in 1701, the next great case is the impeachment of the Tories of the last years of Queen Anne, the traitors Oxford, Bolingbroke, and Ormond. The technical charge was the conclusion of the disgraceful peace of Utrecht; the real charge was attempting to bring in the Pretender. Oxford pleaded the queen's command, but was thrown into prison. He was released in two years and the impeachment abandoned. The other two fled to France, and were convicted on attainder.

The fruitful source of impeachments has been the struggle to obtain the acknowledgment of ministerial responsibility to Parliament. That principle now being fully admitted impeachments have ceased. The only other great case is of a different order. It is the gigantic trial of Warren Hastings on charges of tyranny and extortion towards the native princes of India, which began in 1788, and dragged its weary length along for years. Warren Hastings was acquitted, but his case was none the less a glorious triumph for the champions of humanity, as well as settling the important constitutional principle that trials by impeachment are not now to be interfered with by dissolution nor prorogation, as had been the case under Charles I. with the impeachment of Buckingham.

As said above, the small case of Lord Melville in 1804 closed the long list of these important procedures. It is sincerely to be hoped it may not be reopened, but that the dread of this powerful engine of punishment may be sufficient to deter any minister who may be disposed to outstep the limits of his authority, or act otherwise than for the country's best welfare on what he considers sufficient grounds.

IMPENETRABIL'ITY, a name given to the property of matter, the existence of which is suggested when we see that any attempt to place one solid body in the part of space occupied by another is either resisted by, or its success preceded by the removal of the latter; or, in other words, that no two bodies can at the same time occupy the same space. In some cases the impenetrability of matter can only be taken in conjunction with the hypothesis of its porosity. Otherwise it might be successfully disputed. For instance, salt may be dissolved in water without increasing the bulk of the fluid; the (impenetrable?) matter is then penetrated, or else the matter of the fluid has interstices. But if any attempt be made to press the fluid into a smaller space, the impenetrability of the water will appear by its resistance to the pressing substance. Are we not then making a purely gratuitous introduction of words to supply explanations of phenomena? The answer to this difficulty and others of a similar kind which occur in attempting to define simple mechanical terms, is that the beginner must not receive them as explanations or as doctrines, but simply as statements of observed phenomena, or as terms which imply that explanation is wanted, and serve, till further elucidation, to enable us to recall the phenomena themselves and the

universality of their existence. The notion of impenetrability is founded on the supposition that, when one body approaches another which is at rest, it must be in contact with it before the latter will move; but many circumstances render it highly probable that actual contact never takes place, and that when the bodies are within a certain small distance from one another repulsive forces begin to be exerted between them. The resistance alluded to is apparently therefore dependent on repulsive forces of whose cause and modes of action nothing is known.

IMPER'ATIVE, CATEGOR'ICAL, is a famous term of the philosophy of Immanuel Kant. It may be paraphrased by the term "unconditional command," for (unlike the dictates of prudence, which are founded on reason) it is categorical, that is unconditional, and is indeed the only unconditional command laid upon us. It is, namely, the divine command to *do right*. In Kant's philosophy of the intellect he sharply distinguishes between empirical knowledge (experience) and *a priori* knowledge (transcending experience); so also he draws a similarly rigid line in moral philosophy. The ends at which desire aims, ends which are empirical, that is, rest on experience, and which furnish therefore sensuous and egotistic motives to the will, and may be summed up in the phrase "the search after personal happiness," lie on one side of this line. Upon the other side of the line, corresponding to the *a priori* division of the intellect, lies this single *categorical imperative*, "Act so that the maxim of thy will can at the same time be accepted as the principle of a universal legislation." And this categorical imperative is felt by the soul to stand in glaring contrast to the desire for personal happiness, to all selfish aims. Kant's imperative is not an appeal to reason, like the corresponding doctrine of the utilitarian philosophy, which commands the individual to sacrifice his own selfish happiness to the happiness of the greatest number, and thus gain a higher happiness than any personal aim will give; it is, on the contrary, a command, taking the imperative form, because man is not wholly a rational being, but is often ruled by mere sensuous impulses, and the senses are but too often in direct conflict with the reason. According to Kant we arrive at the consciousness of the categorical imperative, not by thought and experience, but by simple perception. It stands there as a fact before us, and indeed as the only fact of the pure reason. All other facts have limits or conditions. This one fact alone follows from the autonomy of the will—absolute and undetermined.

IMPERA'TOR. See EMPEROR.

IMPER'FECT, that which is not perfect, either in the sense of the design being inferior or simply being unfinished.

In grammar the last sense is the one used. The imperfect tenses of the verb are those which regard a past action at the time when it was not yet complete. We call *I was walking* imperfect, because we are considering the point of time during which the action continued. "Continuous tenses" has been suggested as a preferable term to imperfect on this account. In perfect tenses, on the other hand, the action of the verb is altogether completed, for whether we say *I have walked* or *I shall have walked*, what follows in the sentence depends upon the completeness (*i.e.* perfected state) of the action, though the first relates to past and the second to future events.

In music imperfect is used in both senses. It means incomplete in the term imperfect cadence, better called half-close [see CADENCE], and when applied to intervals or chords; while it means faulty or inferior when used in the ancient divisions of time. In intervals imperfect applies only to the Fourth and Fifth; an imperfect Fourth or Fifth is one which is a semitone short of the complete or perfect interval; thus B to F♯ being a perfect Fifth, B to F is an imperfect one. An imperfect triad is one whose Fifth is imperfect. In each case the sense of incompleteness, the necessity of something to follow, marks the identity of the use of the term with that of the grammarians. (The term "diminished" is now superseding "imperfect.")

In the ancient system of musical time the triple grouping of accents and the corresponding triple division of long notes into smaller notes were called perfect, on the thoroughly scholastic view that the Trinity represented perfection of number or division. The ancient *perfect* notes remain to us in our dotted notes; thus in our own modern usage a dotted minim divides into three, not two, crotchets; and similarly with other dotted notes. Anciently the division was by nature exactly the other way: a note divisible triply was unmarked, because it was "perfect," but if any note were to be divided otherwise than triply it had to be specially marked and distinguished. But since halving and quartering, and grouping by pairs and fours is far more natural and indispensable to the mind than using threes, sixes, and nines, the ancient music was filled with the most complex devices for rendering it "imperfect." Those who wish to realize the enormous difficulties thus laid on the shoulders of the mediæval musician should consult old Thomas Morley or Zarlino.

IMPE'RIAL, the largest nominal gold coin of Russia, of the value of 10 roubles. But the largest actual gold coin of Russia is the half-imperial, equal to 5 roubles, the standard weight of which is 6·544 grammes, and the fineness ·916⅔, which gives it a value, as compared with our sovereign, of 16*s.* 4½*d.* The imperial, if it were coined, would thus be worth £1 12*s.* 9*d.* The mintage is extremely accurate, and Russian imperials have a high and well-deserved reputation in consequence.

IMPERIAL CHAMBER. See AULIC COUNCIL.

IMPE'RIUM, in ancient Rome, was the name given to a power specially conferred by a law passed in the Comitia Curiata, namely, the power to command a military force of citizens for a specified time, with all the necessary authority and privilege. It could not be exercised within the city of Rome itself. He who held the *imperium* was for the time *imperator*. Consuls, proconsuls, &c., received the imperium, governors (or viceroys) being limited in its use to their several provinces. We find Cicero, for instance, as a proconsul in Cilicia, styling himself M. Tullius Cicero Imperator. Caius Julius Cæsar was the first on whom the perpetual imperium was conferred, and he was therefore especially styled imperator, whence our word emperor. Later emperors used the title as an hereditary prænomen, placing it before the personal name, instead of after the name, in the fashion of a title conferred upon the wearer, as was the republican usage and the usage of the first emperors. (So with ourselves the hereditary *Lord* precedes the name, the personal *K.G.*, or *M.P.*, or *B.A.*, or what not, won by or conferred upon the individual, follows the name.) The distinction was highly significant—the hereditary prænomen marked the final extinction of the republic except in form.

IMPETI'GO is a disease of the skin which manifests itself by an eruption of yellow itching pustules, appearing in clusters and terminating in a yellowish or brownish scaly crust. It is most common in children, among whom it is apt to occur on the face, particularly round the mouth, nostrils, or ears, on the hands, or on the feet. It is generally found to be associated with defective nutrition and a weakly sensitive condition of the skin. Treatment consists in insuring a nutritive and wholesome diet, with the use of medicines of a tonic and strengthening character, and the external application of suitable dressings. During the inflammatory stage the blotches should be freely smeared with the oxide of zinc ointment, and when this is passed they should be treated with a lotion of lime water and oxide of zinc, which will assist in drying up the eruption.

IM'PEYAN PHEASANT or **MONAUL** (*Lophophorus impeyanus*) is a magnificent PHEASANT inhabiting the high forest regions of the Himalayas. The male bird is gorgeously adorned. The plumage of the upper surface exhibits the most brilliant changing tints of green, blue, violet, and golden bronze, with an intense metallic lustre. The head bears a crest of elongated metallic-green feathers, generally drooping towards the back of the neck. These plumes have a slender naked shaft, terminated by an oval lustrous lamina. Low down on the back there is a broad band of pure white, and the tail is ample, rounded, and bright chestnut. The lower surface is nearly black. The legs are ashy gray. The length of the male is about 2½ feet. The female is smaller, and reddish-brown, varied with spots and bars of black; the chin and throat and the tip of the tail are white. The vertical range of the impeyan pheasant is high; it always keeps near the line of snow. In winter these birds, more especially the female and young, descend to lower regions, approaching the villages situated on the lower spurs of the mountains. The females lay towards the end of spring from three to five eggs, depositing them in a depression of the ground; the eggs are pale buff sprinkled with reddish-brown. Like nearly all game birds this pheasant is omnivorous. Its note is prolonged and plaintive. It is a lover of solitude, and exhibits none of the pugnacity for which some of its tribe are remarkable.

IMPLU'VIUM, the open rectangular marble basin or cistern which lay beneath the similarly shaped *compluvium* or central aperture in the *atrium*, the great central hall of a Roman house. The roof of the atrium sloped on each side towards the centre, so that the whole of the rain water fell into the impluvium. Sometimes the compluvium is itself styled, but incorrectly, impluvium.

IMPONDERABIL'ITY is a property which has been from time to time predicated as belonging to certain unknown substances, such as caloric (which was thought to be the heat-substance), or the substances through which the forces of light, electricity, magnetism, &c., act upon visible matter. One after the other such imponderable substances have been given up, till one only remains—that imaginary ETHER which is said to pervade all space and even the interstices of solid and fluid bodies, to be perfectly elastic, and while manifestly solid (on account of the nature of the phenomena connected with it, which would be impossible in a fluid medium), to be imponderable, entirely devoid of weight. Ether is our means of conveyance for the vibrations of heat, light, and electricity in the present state of physical science; but the crux of imponderability condemns it as untenable except as a provisional hypothesis. A substance without weight is recognized by all to be a contradiction in terms. Some astronomers point to the known small retardation in Encke's comet (which has a closed orbit) as indicating the existence of ether in the interstellar spaces. As yet this is the only fact (if it is a fact) demonstrating the existence of this last of the "imponderables."

IMPORTS and **EXPORTS** are the various kinds of merchandise brought into and sent from a country. The regulations which govern the bringing of merchandise into and sending it from the United Kingdom are embodied in the Customs Consolidation Act, passed in 1876. A previous Consolidation Act had been passed in the year 1853, but the great alterations in the customs tariff and regulations involved by the repeal of several hundred *ad valorem* and differential duties rendered a revision of the customs law desirable. The new Act comprised provisions which gave largely increased facilities to the mercantile community, and relieved both importers and exporters from all customs restrictions that could be dispensed with. There is probably now no country in the world where fewer or less irksome regulations are imposed upon commerce than in the United Kingdom.

The first of the following tables gives the values of the imports and exports since 1858, and also shows the wonderful increase of the trade of the country in that period; in the second are given all the articles imported and exported in 1884 which exceeded £1,000,000 in value; and the third shows the relative importance of the trade between the United Kingdom and foreign countries.

TABLE I.

	Imports.	Exports.		
		Produce and Manufactures of the United Kingdom.	Foreign and Colonial Merchandise.	Total Exports.
	£	£	£	£
1858	164,583,832	116,608,756	23,174,023	139,782,779
1859	179,182,355	130,411,529	25,281,446	155,692,975
1860	210,530,873	135,891,227	28,630,124	164,521,351
1861	217,485,024	125,102,813	34,529,684	159,632,498
1862	225,716,976	123,992,264	42,175,870	166,168,134
1863	248,919,020	146,602,342	50,300,067	196,902,409
1864	274,863,924	160,436,302	52,220,240	212,656,542
1865	271,072,285	165,835,725	52,995,851	218,831,576
1866	295,290,274	188,917,536	49,988,146	238,905 682
1867	275,183,137	180,961,923	44,873,165	225,835,088
1868	294,693,608	179,677,812	48,100,642	227,778,454
1869	295,460,214	189,953,957	47,061,095	237,075,052
1870	303,257,493	199,586,822	44,493,755	244,080,577
1871	331,015,480	223,066,162	60,508,538	283,574,700
1872	354,693,624	256,257,347	58,331,487	314,588,834
1873	371,289,442	255,164,603	55,840,162	311,004,765
1874	370,054,334	239,558,121	58,092,343	297,650,464
1875	373,939,577	223,465,963	58,146,360	281,612,323
1876	375,154,703	200,639,204	56,137,398	256,776,602
1877	394,273,906	198,893,065	53,452,955	252,346,020
1878	368,609,610	192,848,914	52,634,944	245,483,858
1879	362,991,875	191,531,758	57,251,606	248,783,364
1880	411,229,565	223,060,446	63,354,020	286,414,466
1881	397,022,489	234,022,678	63,060,097	297,082,775
1882	413,019,608	241,467,162	65,193,552	306,660,714
1883	426,891,579	239,799,473	65,637,597	305,437,070
1884	389,904,382	232,927,575	62,443,715	295,371,290
1885	370.404,314	213,044,500	58,359,194	271,403,694
1886	349,381,087	212,363,995	56,107,671	268,471,666

The relative effect of imports and exports upon commercial prosperity is treated of under BALANCE OF TRADE. We here deal chiefly with the statistical part of the subject. Until the latter part of the seventeenth century no opportunities existed for the collection of an authentic account of commercial statistics. Scattered notices of the nature and amount of our trade at various periods may be found interwoven with the narrative of historians, but the authority on which such statements generally rest is usually obscure. As to the money value attached to those imports and exports, we may safely conclude, especially in regard to imports, that it was derived from the assessment which regulated the system of poundage — an assessment which, though conventionally representing the marketable worth of the various descriptions of merchandise subject to a uniform percentage, was arbitrary in effect, and admitted of adjustments by which the assumed prices of particular commodities were either raised or lowered, so as to aggravate or lighten the pressure of the tax. Artifices of this kind were not inconsistent with the spirit of an age imperfectly civilized and ignorant of the true principles of commercial policy. More correct views, however, began to be entertained of the real interests of the country, and of the use to be derived from commercial statistics. One evidence of this change of feeling is afforded by the institution of the Board of Trade in 1670; another is to be found in the establishment of the office of inspector-general of imports and exports in 1697, whereby provision was made that an account should be kept of the trade carried on by England with each foreign country and with each of the British settlements and possessions abroad, showing the goods imported and exported, methodically enumerated and classified; their quantities by weight, tale, or measure, and their equivalent in money computed at certain official rates of valuation then first assigned.

TABLE II.—A LIST OF ALL THE ARTICLES IMPORTED INTO, AND EXPORTED FROM, THE UNITED KINGDOM, IN THE YEAR 1886, OF WHICH THE VALUE EXCEEDED £1,000,000.

		Quantities	
Animals living—			£
Oxen and bulls, . . .	number,	241,860	58
Sheep and lambs, . .		1,038,967	2,011,198
Corn—			
Wheat, ...		47,404,344	17,888,155
Wheat meal and flour,		14,739,232	8,254,407
Barley, ...		13,722,609	3,968,437
Oats, ...		13,495,190	3,974,434
Maize, ...		30,998,278	7,614,113
Articles of food and drink—			
Bacon, ...		3,255,968	6,142,470
Beef, fresh and salted, .		1,101,931	2,187,576
Hams, ...		943,379	2,236,872
Preserved meat, . . .		430,346	1,167,010
Mutton, fresh, ...			1,404,888
Butter, ...		1,543,404	8,140,188
Butterine, ...		886,573	2,958,300
Cheese, ...		1,733,187	3,867,896
Eggs, ...	gt. hnds.,	8,613,162	2,879,000
Fish, ...	cwts.,	831,655	1,422,246
Oranges and lemons, . .	bush.,	4,387,233	1,491,533
Fruit, raw, ...	"	2,601,558	1,290,411
Lard, ...	cwts.,	896,324	1,546,190
Rice, ...		6,589,138	2,465,826
Spices, ...		—	1,064,756
Sugar—Refined, ...	cwts.,	6,367,027	5,319,449
" Unrefined, . . .		16,141,006	10,540,438
Coffee, ...		1,029,462	3,346,907
Currants, ...		843,425	1,051,012
Tea, ...	lbs.,	230,895,292	11,360,460
Brandy, ...	galls.,	3,139,022	1,424,942
Wine, ...		14,561,913	5,134,879
Tobacco, ...	lbs.,	87,022,051	3,761,577
Metals—			
Copper and copper ore, .	tons,	196,565	3,940,857
Iron and steel, ...		2,993,596	2,963,519
Lead, ...		107,878	1,372,262
Pyrites of iron or copper,		556,181	1,028,142
Tin, ...	cwts.,	483,506	2,327,974
Chemicals, dye substances, &c.,			7,952,149
Oils, ...			6,049,148
Raw materials for textile manufactures—			
Cotton, ...		15,187,299	37,792,413
Flax, ...		1,287,034	2,416,117
Hemp, ...		1,213,857	1,726,822
Jute, ...		5,354,485	3,010,051
Silk—Raw, ...	lbs.,	2,230,039	1,530,927
Wool, ...		591,872,167	22,372,514
Goats' wool, ...		19,184,312	1,120,362
Raw materials for sundry industries—			
Caoutchouc, ...	cwts.,	192,518	2,202,746
Hides—Dry, ...		721,964	2,360,445
" Wet, ...		499,271	1,249,569
Tallow and stearine, . .	cwts.,	1,010,396	1,296,552
Wood and timber (hewn),	loads,	1,577,992	3,405,526
" (sawn or split),		3,783,200	8,197,619
Manufactured articles—			
Cotton manufs. (all kinds),			1,860,068
Iron "	cwts.,	3,553,528	2,202,716
Leather " . . .	lbs.,	77,619,090	5,524,335
Gloves, ...	doz. pairs	1,407,311	1,526,732
Paper, ...			1,491,903
Silk manufs. (broad stuffs),			5,594,419
Ribbons (silk or satin), .			2,159,689
Silk manufactures (unenumerated), ...			2,807,825
Woollen manufactures, .			5,565,205
" " (unenumerated), . .			2,076,673
Woollen yarn, . . .			2,228,715
Miscellaneous articles—			
Oil seed cakes, ...	tons,	296,530	1,887,951
Seeds—Cotton, . .		255,701	1,498,011
" Flax and linseed,	quarters,	2,081,283	4,266,998

EXPORTS.—*British and Irish Produce and Manufactures.*

		Quantities.	Value.
Articles of food and drink—			£
Beer and ale, ...	barrels,	420,301	1,582,731
Fish (herrings), ...		1,065,185	1,260,215
Pickles, &c., ...			1,152,896
Provisions (includ. meat),			1,016,550
Raw materials—			
Coal, coke, cinders, &c., .	tons,	23,284,960	
Articles manufactured and partly manufactured—			
A. *Yarns and textile fabrics—*			
Cotton yarn & twist, . .	lbs.,	254,346,100	1,488,803
" piece goods, . .	yards,	4,850,080,200	50,170,634
Lace and patent net, . .	—	—	2,368,236
Thread, ...	lbs.,	17,313,900	2,586,946
Other cotton manufs., .	—	—	1,381,071
Jute yarn and manufs., .	—	—	1,824,718
Linen yarn, ...	lbs.,	15,890,900	935,083
" manufactures, . .	—	—	5,257,374
Silk manufactures, . . .	—	—	2,233,807
Woollen and worsted yarn,	lbs.,	45,627,100	4,406,676
Woollen & worsted manufactures, ...	yards,	89,779,700	9,155,491
Worsted fabrics, . . .	"	160,167,500	6,943,261
Carpets, ...	"	11,630,700	1,231,961
Blankets, hosiery, and small wares, ...	—	—	1,968,140
Alpaca and mohair yarn,	lbs.,	14,433,600	1,385,241
B. *Metals—*			
Copper—Wrought, . .	cwts.,	358,536	931,539
" Unwrought, . .	"	380,712	834,537
Mixed or yellow metal, .	"	398,587	816,140
Hardware & cutlery, . .	—	—	2,846,804
Iron—Pig, ...	tons,	1,044,257	2,252,944
" Bar, angle, bolt, rod,		243,386	1,378,065
" Railroad, ...		739,651	3,688,733
" Hoops, sheets, and boiler plates, . .		307,135	3,058,703
Tin plates and sheets, .		334,775	4,639,484
Cast and wrought iron, .		355,879	3,879,241
Steel, ...		165,833	1,487,222
Telegraph wire and apparatus, ...			992,118
C. *Machinery and mill work—*			
Steam engines, ...			3,012,675
Other descriptions, . . .			7,121,194
D. *Apparel and articles of personal use—*			
Apparel and slops, . . .			3,902,373
Haberdashery, millinery, &c., ...			2,094,067
Hats	dozens,	1,133,361	1,086,401
Leather boots and shoes, .	doz. pairs	530,222	1,547,633
E. *Chemicals, chemical and medicinal preparations—*			
Alkali, ...	cwts.,	6,242,188	1,788,060
Manure (chemical), . .			1,617,053
F. *All other articles—*			
Arms, ammunition, &c., .			1,637,063
Bags and sacks, ...	dozens	3,661,574	704,707
Printed books, ...	cwts.,	122,893	1,116,683
Caoutchouc manufactures			971,052
Carriages, ...			913,947
Earthenware and china, .			1,802,966
Glass of all kinds, . . .			972,213
Leather, wrought and unwrought, ...			1,650,443
Oil, ...	galls.,	17,674,000	1,502,956
Painters' colours, &c., . .	—	—	1,265,032
Paper, ...	cwts.,	791,358	1,501,257
Skins and furs, ...	—	—	842,148
Iron and steel rails, . .	tons,	526,187	2,483,083

Foreign and Colonial Produce.

Caoutchouc,	cwts.,	109,416	1,281,499
Coffee, . .		772,879	2,586,931
Cotton, . .		1,766,769	3,978,808
Hides, . .		515,048	1,745,724
Indigo, . .		53,959	1,170,242
Jute, . . .		1,883,285	1,095,259
Leather, .	lbs.,	17,140,117	1,402,515
Rice, . . .	cwts.,		1,359,671
Tea, . . .	lbs.	44,418,052	2,198,469
Tin, . . .	cwts.,	287,618	1,396,615
Wool, . .	lbs.,	310,388,017	11,986,117

TABLE III.

IMPORTS INTO THE UNITED KINGDOM IN 1885 AND 1886.

Countries from which Imported.	1885.	1886.
FOREIGN.	£	£
Russia, Northern Ports,	10,930,962	8,520,580
" Southern Ports,	6,766,137	5,032,191
	17,697,099	13,552,771
Sweden,	8,114,493	7,476,114
Norway,	2,833,822	2,783,708
Denmark,	4,820,581	4,916,486
Germany,	23,080,498	21,381,892
Holland,	25,012,765	25,311,685
Belgium,	15,055,464	14,236,566
France,	35,712,357	36,598,434
Portugal	2,669,755	2,551,960
" Azores,	105,645	69,193
" Madeira,	69,359	73,920
Spain,	9,449,379	9,122,080
" Canary Islands,	93,734	107,623
Italy,	3,009,061	2,769,037
Austrian Territories,	2,165,252	1,618,757
Greece,	1,932,542	1,550,529
Montenegro,	—	—
Bulgaria,	302,411	76,064
Servia,	—	—
Roumania,	2,751,671	2,650,420
Turkish Dominions:		
European Turkey,	1,491,333	1,284,746
Asiatic Turkey (including the Island of Cyprus, El Hedjaz, and Ports in Persian Gulf),	3,171,986	2,832,293
Egypt,	8,691,817	7,174,410
Tripoli,	389,665	273,732
Tunis,	147,110	97,108
Algeria,	880,152	699,065
Morocco,	484,135	481,486
Spanish Ports in Northern Africa,		
French Possessions in Western Africa,	13,237	15,147
Fernando Po,	10,457	6,874
Portuguese Possessions in Western Africa,	99,891	91,146
Western Coast of Africa, not particularly designated,	1,222,865	962,247
Eastern Coast of Africa:		
Portuguese Possessions,	15,791	26,437
Native States,	127,652	79,929
Abyssinia,	—	4
Madagascar,	10,545	7,227
Bourbon (Réunion),		
Arabia:		
Territories of the Sultan of Oman (Muscat),	904	1,100
Other Native States,	—	—
Persia,	78,500	85,177
India:		
French Possessions,	18,612	17,759
Portuguese Possessions,	3,008	5
Dutch Possessions:		
Java,	3,036,761	3,158,808
Other Possessions in the Indian Seas,	19,640	3,700
Spanish Possessions:		
Philippine Islands,	981,783	797,690
Native Islands in the Indian Seas:		
Borneo,	120	6
Other Islands,	14,186	14,273
Siam,	90,535	104,947
Cochin China,	97,395	5,242
China (exclusive of Hong Kong),	8,570,090	8,080,082
Macao,	5,384	21,173
Japan,	495,410	561,504
Islands in the Pacific,	83,664	100,199
French Possessions in N. America,		
United States:		
On the Atlantic,	78,935,810	75,804,387
On the Pacific,	7,222,411	5,563,077

Countries from which Imported.	1885.	1886.
FOREIGN—*continued.*		£
Spanish West India Islands,		189,246
French " "	701	503
Dutch " "	59,523	50,116
Danish " "	16,878	14,051
French Guiana,	45	—
Dutch Guiana,	41,115	36,384
Hayti and St. Domingo,	111,789	93,295
Mexico,	723,061	590,578
Central America,	1,072,255	1,113,013
United States of Colombia,	233,617	292,149
Venezuela,	226,744	144,877
Ecuador,	158,710	226,396
Peru,	1,875,206	1,657,732
Bolivia,	200,046	190,619
Chili (including the Pacific Coast of Patagonia),	2,484,038	2,261,948
Brazil,	4,087,557	3,488,945
Uruguay,	624,393	
Argentine Republic (including the		413,478
Atlantic Coast of Patagonia),	1,876,378	1,648,413
Paraguay,	—	—
Whale Fisheries, Northern,	62,901	49,522
" " Southern,		
Total from Foreign Countries,	286,027,532	267,612,484
BRITISH POSSESSIONS.		
Heligoland,		
Channel Islands,	800,150	886,946
Gibraltar,	15,101	31,123
Malta,	77,570	90,709
West Africa Settlements,	140,598	154,201
The Gold Coast (including Lagos),	734,394	658,552
Ascension,	3,000	15
St. Helena,	2,184	307
British Possessions in South Africa:		
Cape of Good Hope,	4,409,565	3,976,463
Natal,	724,302	681,571
Mauritius and Dependencies,	310,078	310,022
Aden and Dependencies,	217,518	248,025
East Indies:		
Bombay and Sind,	9,578,907	8,623,414
Madras,	3,721,247	3,966,565
Bengal and British Burma,	18,601,077	19,527,644
The Straits Settlements,	4,453,351	4,372,975
Labuan,	—	—
Ceylon,	2,400,593	2,089,107
Hong Kong,	976,219	1,557,062
Australasia:		
West Australia,	313,855	269,882
South Australia,	3,709,775	2,466,862
Victoria,	6,174,846	4,853,506
New South Wales,	7,951,622	7,066,312
Queensland,	1,891,899	1,303,076
Tasmania,	348,448	248,406
New Zealand,	5,674,583	4,719,442
Fiji Islands,	50,806	39,247
British North America:		
Dominion of Canada,	9,945,334	10,035,984
Newfoundland,	383,547	358,480
Bermudas,	4,712	5,577
British West India Islands,	2,583,871	1,561,108
British Honduras,	228,640	215,811
British Guiana,	1,417,410	1,383,431
Falkland Islands,	81,261	105,384
Total from British Possessions,	87,876,553	81,807,209
Total from Foreign Countries and British Possessions,	373,904,085	349,419,693

TABLE III.

EXPORTS OF BRITISH AND IRISH PRODUCE AND MANUFACTURES IN 1885 AND 1886.

Countries to which Exported.	1885.	1886.
	£	£
FOREIGN.		
Russia, Northern Ports,	3,479,307	3,249,893
" Southern Ports,	712,245	1,174,366
	4,191,552	4,423,759
Sweden,	2,178,252	2,067,304
Norway,	1,331,166	1,203,781
Denmark,	1,903,055	1,730,815
Germany,	16,415,984	15,691,282
Holland,	8,878,060	8,197,939
Belgium,	7,806,357	7,137,050
France,	14,978,990	13,611,802
Portugal	1,748,231	1,842,621
" Azores,	58,188	45,883
" Madeira,	81,161	86,465
Spain,	3,163,234	3,106,464
" Canary Islands,	189,125	372,345
Italy,	6,627,165	6,094,938
Austrian Territories,	788,426	905,995
Greece,	873,678	983,610
Montenegro,	—	—
Bulgaria,	71,378	56,391
Servia,	—	—
Roumania,	791,885	929,730
Turkish Dominions:		
European Turkey,	3,103,304	3,283,669
Asiatic Turkey (including the Island of Cyprus, El Hedjaz, and Ports in Persian Gulf),	3,029,491	2,620,500
Egypt,	3,481,538	2,858,844
Tripoli,	9,443	6,077
Tunis,	75,637	78,738
Algeria,	356,716	271,140
Morocco,	427,283	463,875
Spanish Ports in Northern Africa,		2,870
French Possessions in Western Africa,	196,833	56,718
Fernando Po,	8,637	8,083
Portuguese Possessions in Western Africa,	308,840	315,180
Western Coast of Africa, not particularly designated,	779,263	715,515
Eastern Coast of Africa:		
Portuguese Possessions,	52,741	48,837
Native States,	203,054	118,539
Abyssinia,	14,691	7,561
Madagascar,	6,729	56,258
Bourbon (Réunion),	33,570	17,541
Arabia:		
Territories of the Sultan of Oman (Muscat),	1,249	732
Other Native States,	—	—
Persia,	317,528	120,445
India:		
French Possessions,	9,380	6,681
Portuguese Possessions,	45,556	36,457
Dutch Possessions:		
Java,	1,564,346	1,268,032
Other Possessions in the Indian Seas,	191,690	121,473
Spanish Possessions:		
Philippine Islands,	955,962	839,686
Native Islands in the Indian Seas:		
Borneo,	985	1,879
Other Islands,	1,551	1,217
Siam,	51,062	65,359
Cochin China,	82,860	[illegible]
China (exclusive of Hong Kong),	5,187,288	5,249,302
Macao,	—	—
Japan,	2,077,287	2,168,074
Islands in the Pacific,	88,209	86,767
French Possessions in N. America,	5,346	5,880
United States:		
On the Atlantic,	21,444,402	26,105,911
On the Pacific,	549,419	715,738
FOREIGN—*continued.*	£	£
Spanish West India Islands,	1,461,920	1,741,022
French " "	161,189	176,863
Dutch " "	119,419	136,210
Danish " "	110,980	95,159
French Guiana,	4,001	7,595
Dutch Guiana,	24,881	27,188
Hayti and St. Domingo,	362,126	271,187
Mexico,	796,011	900,740
Central America,	670,467	679,155
United States of Colombia,	660,124	938,859
Venezuela,	337,692	450,885
Ecuador,	129,428	254,960
Peru,	704,151	865,018
Bolivia,	64,276	54,927
Chili (including the Pacific Coast of Patagonia),	1,404,866	1,610,448
Brazil,	5,348,844	6,066,710
Uruguay,	1,406,742	1,253,178
Argentine Republic (including the Atlantic Coast of Patagonia),	4,660,460	5,191,825
Paraguay,		
Whale Fisheries, Northern,		
" " Southern,		
Total to Foreign Countries,	135,114,874	136,950,258
BRITISH POSSESSIONS.		
Heligoland,	33	123
Channel Islands,	511,991	465,741
Gibraltar,	624,996	599,943
Malta,	1,027,282	923,088
West Africa Settlements,	213,917	392,828
The Gold Coast (including Lagos),	452,086	393,905
Ascension,	1,638	1,585
St. Helena,	16,962	16,601
British Possessions in South Africa:		
Cape of Good Hope,	2,838,938	2,429,650
Natal,	985,599	878,028
Mauritius and Dependencies,	263,021	260,927
Aden and Dependencies,	179,038	98,880
East Indies:		
Bombay and Sind,	12,310,841	13,105,154
Madras,	2,471,486	2,834,226
Bengal and British Burma,	14,506,810	15,406,160
The Straits Settlements,	2,345,102	2,104,297
Labuan,	—	—
Ceylon,	533,371	565,043
Hong Kong,	3,757,523	2,810,359
Australasia:		
West Australia,	275,440	380,380
South Australia,	2,237,626	1,518,202
Victoria,	6,706,520	6,768,893
New South Wales,	9,106,784	7,618,203
Queensland,	2,449,624	2,215,774
Tasmania,	455,480	556,836
New Zealand,	3,901,070	3,805,162
Fiji Islands,	34,222	[illegible]
British North America:		
Dominion of Canada,	6,838,634	7,546,594
Newfoundland,	367,549	340,421
Bermudas,	64,459	71,728
British West India Islands,	1,815,955	1,686,691
British Honduras,	91,493	76,277
British Guiana,	523,665	584,904
Falkland Islands,	20,971	34,016
Total to British Possessions,	77,929,626	75,513,737
Total to Foreign Countries and British Possessions,	213,044,500	212,463,995

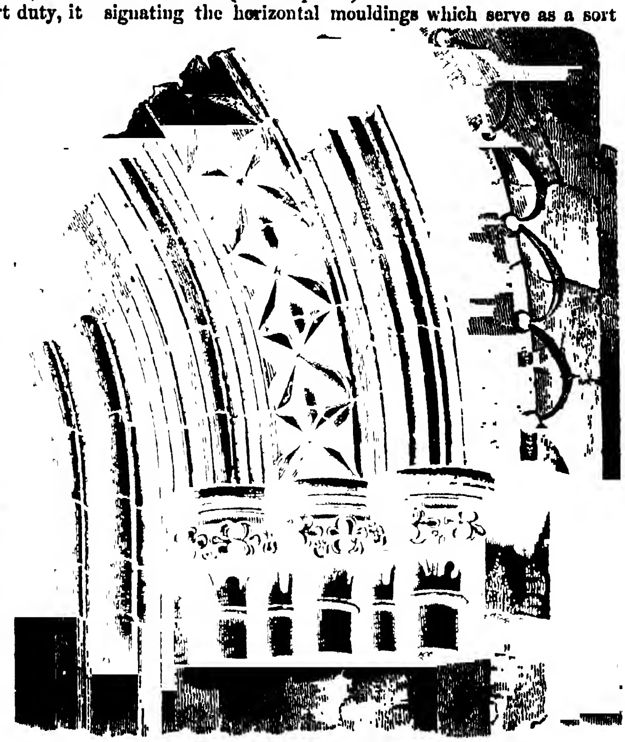
The weak point of this scheme was the fixed character of the official rates of valuation by which the amounts of the imports and exports were henceforward estimated. Those rates, it is reasonable to presume, corresponded as nearly as possible with the actual prices of the several commodities at the time when they were established. The general results obtained by their use would, therefore, for some years approach pretty closely to the truth; but the difference between the computed official value and the unascertained real value, whose place it supplied, was always growing wider, and as commerce and manufactures enlarged the sphere of their activity the divergence became rapid, until at last all traces of the original agreement between the official and the real value were nearly effaced, and the habit of regarding the former as identical with the latter at length was very generally abandoned.

A partial improvement took place in 1798, when to assist in defraying the expenses of the war the "convoy duty" was imposed on the exports of British produce and manufactures. This being rated *ad valorem*, it was provided by the Act of Parliament under which it was levied that the shippers of such merchandise should make a declaration of its actual value, and that a false declaration should render the party liable to a penalty. Thus was laid the foundation of an authentic record of the real value of one great branch of our commerce. The utility of this enactment was soon perceived, and some years later, after certain goods had been exempted from the export duty, it was deemed expedient to pass a special Act (35 Geo. III. c. 98) providing that in all cases the shippers of "free goods" should be held liable to furnish a declaration of value. In 1842 the last remnant of the *ad valorem* export duty was swept away; but the declaration of value continues to be required on the exportation of all goods from the United Kingdom, and it constitutes the only source of information from which statistics can be compiled on that subject. That the establishment of a record of the real value of British exports would be followed by the institution of some corresponding registry of the real value of imports might have been expected, but it was not until 1854 that steps were taken to carry it thoroughly into effect. In that year the Treasury sanctioned a plan under which merchants were bound to declare the value of certain articles imported, and that of others was ascertained by the customs authorities, who employed special officers for the purpose. In the reorganization of the customs service in 1871 the system of employing the latter was abolished, and merchants are now required to declare the value of all articles imported. If the customs officers are not satisfied with the correctness of the statements they are entitled to have them amended.

IMPOSI'TIONS, illegal dues in the nature of customs duties, levied by royal authority alone. The great law case of impositions, or the Bates case, which by its manifest injustice proved eventually one of the foundations of English liberty, was argued in the Court of Exchequer against the crown in the time of James I., in the year 1606. The right of the crown to make impositions, that is, to impose dues upon merchandise, had for centuries been successfully resisted by the Parliament, indeed from the times of Edward I., creator of Parliaments. Customs (*i.e.* customary dues) were granted from time to time [see TAXATION] with the express motive of enabling the king by the money so raised to protect commerce. Yet in the decay of Parliament under the masterful Tudors occasional impositions were successfully made beyond the legal customs of 6*d.* in the pound, 2*s.* on the cask (of wine), 10*s.* on the sack (of wool), &c. Thus Mary imposed a duty on foreign cloth by proclamation in 1557, and another on French wines; Elizabeth also levied successfully an imposition on sweet wines. But when the Stuarts attempted to mimic the arbitrariness of their predecessors the result was far otherwise; and opposition arose on every side, culminating in the famous Bates case, or the "Case of Impositions" (Exchequer, 4 Jac. I.)

John Bates, a Levant merchant, refused to pay a duty of 5*s.* a hundredweight on currants over and above the poundage of 6*d.* on each £1 value, which James I. had imposed by royal order. The subservience of the judges led them to give judgment for the crown on the grounds that (1) customs are the result of foreign affairs, all matters relating to which are necessarily in the hands of the king; (2) seaports are the king's gates, which he can open and shut at pleasure; (3) old customs had been imposed by prerogative; and (4) the abandonment of this prerogative by many previous sovereigns could not bind their successors. All men who had eyes could see that this was the preparation for an absolute tyranny; and the outcome of the steadily growing discontent which now began was the formal forbidding of impositions for the future by the first article of the Petition of Right (1628), under Charles I.

IM'POST (Ital. *imposta*) is an architectural term designating the horizontal mouldings which serve as a sort of cap or cornice to the piers of arches, and by which the archivolts or curved mouldings and fasciæ surrounding the arches themselves are supported. Like these latter, the impost is made plainer or richer according to the general character of the design. And when the archivolts of the arches are omitted, either the impost is omitted likewise or a plain band is substituted for it, as is generally done in the rusticated basements beneath one of the "classical orders"—the joints of the rustics sufficing for decoration,



Imposts of Piers of Arches.

and giving the requisite architectural expression. Except in this case the impost is essential in classical architecture. Its omission in such styles has always a very mean and poor effect. But it is in the later styles of architecture that the impost rises to its greatest dignity of expression. The truer use of the arch necessitated the ennobling of the impost, which is the starting-point and foundation whence the arch springs. The beautiful example given is from the cathedral of Elgin.

IMPOUND'ING. Occupiers of land have the right to seize and impound all cattle which may stray on their property. They may either detain them on their own premises or take them to the nearest pound—that is, a public place inclosed for the purpose—till the amount of damage which they have committed is paid for. In either case they must feed and water the cattle (at the owner's expense), and they cannot impound them at all unless they are found actually straying on their land. In Scotland the power is called the pounding of strayed cattle.

IMPOUNDING A DOCUMENT is a legal phrase used to denote that a document produced at a trial is, by order of the court, taken possession of by its officers instead of being returned to the owner, that it may be retained until a question affecting it is decided, or in order to enable a prosecution to be brought if necessary.

IMPRESS'MENT was a method formerly resorted to for manning the British navy when a sufficient number of volunteers could not be obtained. Though no statute had given or declared such a power to vest in the crown it was claimed as a right, and this claim has received the sanction of numerous Acts of Parliament passed to regulate the practice. Such are 2 Richard II. (1378), 2 Mary (1555), 5 Eliz. (1562), 7 William & Mary (1696), 2 & 4 Anne (1703–5), 13 Geo. II. (1740), 50 Geo. III. (1810), and 6 Will. IV. (1836). Since 1836 no Act relating to it has been passed. According to Lord Kenyon the right of impressment is founded on the common law of England, and its influence extends to all seafaring persons. During the period of the great naval wars of England the press-gang was a source of terror to all the coast towns visited by men-of-war, as well as to the watermen of the metropolis, and fierce fights often took place between the sailors appointed to seize recruits and the populace. All seafaring men between the ages of eighteen and fifty-five were liable to seizure in this way, but in times of emergency landsmen were often captured as well and forced to serve. The power of seizure extended to sea as well as land, and a merchantman or privateer might be compelledt o part with some of her best men for the national service. We have referred to impressment in the past tense, for it has not been resorted to for many years, and it is not likely that recourse will be had to it again. At the same time the old laws remain in force, and the power is kept in reserve for use if circumstances should render it absolutely necessary.

Impressment in the army, on the other hand, is a power always jealously forbidden to the crown in England, though in the modified form of the CONSCRIPTION it has long been the law of the state in foreign countries. Even as early as Edward III. a statute was passed (1327) against compulsory military service. This was confirmed during the height of the seven French wars of that reign, in 1352. Henry IV. when he was beginning his revival of the costly French quarrel, soon after his usurpation of the crown, had to submit to the demand of his Parliament on this head, and to expressly abandon the power of impressment for the army in 1408. But the final settlement of the question was due to the Long Parliament, under which, in 1641, it was enacted that "by the law of this realm none of his Majesty's (Charles I.) subjects ought to be impressed or compelled to go out of his country to serve as a soldier in the wars, except in case of necessity by the coming in of strange enemies into the kingdom." Yet during the American War George III. was expressly empowered by Parliament to impress for the army any "idle and disorderly persons" whom his officers could apprehend.

IMPRIMA'TUR, a license to print a book, &c., which is granted by the licenser in those countries where censorship of the press is exercised in its rigour. The power of granting or withholding this license was assumed by an Act of the Long Parliament passed in 1647. After the Restoration the same power was assumed by King, Parliament, and Privy Council. This state of things continued till the Revolution of 1688.

IMPROMP'TU, a composition of fine art, especially of poetry or music, supposed to be hit off on the spur of the moment. In reality the apparently unstudied nature of such performances is usually the result of the most subtle powers of art, for the "art of concealing art" (*ars celare artem*), as Horace justly says, is the fine flower of the artist's skill. Still, if the hearer receive the impression that the production results from a spontaneous burst of irrepressible feeling called forth by the stimulus which the artist confesses to have received, the title seems fairly appropriate, although, as hinted above, the original inspiration may have received every heightened grace that arduous labour can bestow upon it. Even then the word "fantasia" or "caprice" would serve as well. But if, as in the case of the so-called "impromptus" of Schubert, the piece is in regular form, without waywardness or spontaneity, whatever may be its exalted worth, the name is absurd. Happily in the case named there is clear proof that Schubert never called the pieces by this misnomer. Probably (so Schumann thinks) they are some of them parts of a sonata. They were separately brought out under this incorrect title by the music-publisher Haslinger after Schubert's death.

It says much for the honesty of the great composers that neither Schubert, Mendelssohn, nor Weber ever used the word. As a matter of course Beethoven did not; to produce anything which had not stood the fire of those wonderful sketch-books of his would have seemed to him artistic heresy; and to call a careful composition an "impromptu" would have been in his eyes to tell a simple falsehood.

IMPROPERI'A (Lat., the reproaches), a service of the Roman Catholic Church, part of the Good Friday ceremonies in Holy Week. The *Improperia* have their own plain-song music, as shown in the ordinary manuals, but there is a very famous special musical setting used at Rome, in the Sistine Chapel and elsewhere, composed by Palestrina from some very ancient *Faux Bourdons*, simple archaic harmonies, exquisitely beautiful in spite of their great age. The impression produced on Mendelssohn by the Improperia as rendered by the pope's choir was profound. He had talked with the aged Goethe about the Holy Week ceremonies, and he says in a letter from Rome, written after hearing this service in its proper place on Good Friday (1831), "I quite understand why the Improperia produced the strongest effect on Goethe, for they are the most nearly faultless of all, as both music and ceremonies and everything connected with them are in the most perfect harmony. . . . It seems to me one of Palestrina's finest works, and is sung with surprising delicacy and breadth of expression. . . . The effect of the whole is undoubtedly superb;" and then he quotes parts of the music jotted down with a pencil as he stood in the chapel.

It is difficult in the present attitude of reserve which the pope imposes on himself to hear this service of Palestrina's, once one of the (musical) wonders of the world. The text of the Improperia is composed of "reproaches" addressed by the Lord to his disobedient and ungrateful people. The choir is divided, and sing the reproaches and the responses of penitence alternately. In the Sistine

Chapel service, upon the original antique harmonies as edited by Palestrina, beautiful and extremely subtle *embellimenti* are woven by the singers, and these are handed down by tradition, never having been reduced to writing except by those who (like Mendelssohn) have been clever enough to seize parts of them as they were heard. The entire effect cannot be reproduced, because it has a certain freedom and "give and take" among the voices which probably the singers themselves could hardly reproduce consciously. The whole is so soft, so deliciously vague and intricate, as to yield a new musical sensation to the fortunate hearer. It has also the highest merit of all, that of perfect consistency with the expression of the words. While this stream of mysterious melancholy and pleading floats above, rather felt than consciously heard, all present, two by two, approach a small crucifix lying on the altar steps, kneel, and stooping kiss the feet of the Lord. The mixture of Greek and Latin phrases, which indicates the Eastern origin of the ritual (compare the *Kyrie eleeison* of the Mass), occurs here also; Mendelssohn quotes for the sake of its remarkable music an *Agios O Theos*, and the reply to it in Latin from the second choir *Sanctus Deus*, each expression meaning alike "O holy Lord." This is repeated more or less often as there are more or less persons to take part in the "creeping to the cross," and the musician may share Mendelssohn's lament, if the crowd be not very great, "I unluckily had not the opportunity of hearing it as often as I could have wished."

After all have crept to the cross the candles are lit, and the sacrament is restored to the altar in a grand procession; then other ceremonies succeed, of a joyful character.

The music of the Improperia does not exist in Palestrina's works, for it was jealously kept traditional; but Proske ("Musica Divina," 1863) copied it carefully from old MSS. in the Vatican, and this is undoubtedly the best edition, and more likely to show the chords in their simple state as Palestrina left them. Novello's "Music of Holy Week" (1840) is a copy of Burney's edition (1771), and both this and the very different edition of Alfieri (1840) are reproductions, or attempts at such, of the effect of the music as sung. Consequently as they give the *embellimenti* (or try to do so) they differ most materially from each other, and still more from Proske. It is only as we might have expected; the singers are found to have varied greatly in their traditional rendering during the seventy years between 1770 and 1840. No doubt a transcript of to-day would show still greater deviations. Besides, it is improbable from the nature of the case that effects so subtle and transitory were correctly noted, however great may have been the care taken.

IMPROPRIA'TOR or **LAY-IMPROPRIATOR** is the name of a class of persons whose existence certainly seems indefensible, though it is of ancient date. To impropriate is to divert a fund from religious to lay uses, and thus to rob the church and her congregations for the benefit of some individual layman. The boy-bishops and boy-abbots of the middle ages are known to all as only too common little princelings who absorbed the wealth which, so far as the dim understanding of the times went, was devoted to the highest uses known to man. That it proved otherwise, that the wealth of the church was put to base uses, and that in the order of things it was a good thing that the revenues were reduced by these robberies, is no defence for those who perpetrated them. The greatest source, however, of the many lay-impropriators who still exist in England was the dissolution of the monasteries under Henry VIII. These persons, either the nominees of the crown, whether of Henry or his successors, or purchasers from those nominees, receive the whole tithes or parts of them, subject only to providing a minister for the flock thus bereft of its head or rector. Such a minister is called a *vicar* (or representative); and those vicars who are thus appointed, and who have no other emoluments, fare indeed miserably for the most part. In many cases in the country the vicar receives the small tithes which are sometimes fairly remunerative, and on certain lands are worth more than the great tithes of the rector or of the lay-impropriator; but in towns (as in London) there are few inquiring persons who do not know of very hard cases, where a pittance of a few pounds, doled out as a salary to the vicar by the lay-impropriator who drains the parishioners of their heavy tithes, has to be supplemented by these same parishioners through a public annual subscription, since they prefer to pay for their religious services twice over rather than to see their minister starve.

When James VI. of Scotland became king of England, and the mighty hand of the Tudors was withdrawn, men hoped for better things; no one probably thought that lay-impropriators would be still flourishing in England at the close of the nineteenth century, three centuries later or near it! Consequently upon James's arrival in London the party of truly religious men, called Puritans, which had grown up as a reaction against the brilliant paganism of Elizabeth, waited upon the king with the *millenary petition* (signed by 1000, Lat. *mille*, clergymen of the Church of England) and other petitions on this and kindred subjects; and in January, 1604, the Hampton Court Conference was held. The first demand at that conference was for a new and correcter translation of the Bible and was granted; the second was that lay-impropriators might be taxed to a seventh of their ill-gotten gains in order to provide and properly maintain ministers where none then were, and this the pious king refused! With the rest of the demands, all refused, we have nothing here to do, nor with the contemptuous dismissal of the conference by the king.

Twenty years later, the grievance having grown worse by time as naturally fell out, a plan was formed privately among godly folk for buying out such impropriators as might be willing to sell. The founder of this was a certain Dr. Preston. His scheme was warmly taken up by the great London merchants, nearly all Puritans; and in 1624 arose the famous Feoffees for Impropriations, trustees for the funds collected for these uses, funds which rapidly amounted to considerable sums. The feoffees purchased advowsons, impropriations, &c., as they offered; and then, finding their funds still in excess they engaged preachers or lecturers whom they sent freely about the country, early in Charles I.'s reign. Such doings were nowise to the liking of Archbishop Laud, who, after many unsuccessful attacks upon the feoffees, for they were acting in a perfectly legal manner, haled them and their enterprise into the Star Chamber, 13th February, 1633, and there—ordinary law having no power—at length procured their arbitrary suppression and the imposition upon them of heavy fines for the "evil" work they had done. The loss of the feoffees over the prosecution was £1800, a large sum in those days; of the amount of fines actually levied there remains no authentic record. The livings they had purchased were forfeited to the crown.

IMPROVVISATO'RI are extempore versifiers upon any subject. This practice is of frequent occurrence in Italy, and the facilities which the structure of the Italian language affords to versification and rhyme are of great assistance towards it. The improvvisatore delivers his verse generally accompanied by a guitar, and with a sort of chanting cadence; and he spins out hundreds, nay at times thousands of lines, with apparent ease: whole dramas have been thus delivered. It must not be imagined, however, that this kind of extempore poetry has real merit beyond its unexpected production; in reality very few of these compositions can stand the test of publication. Still they have the merit of the flow of language and the quick adaptation of accessory ideas and images to the main subject,

which rivet the attention and excite the surprise of the listener.

Some improvvisatori have been men of real information and poetical genius, and their compositions are consequently superior to the majority. Gianna, of Genoa, was made improvvisatore to Napoleon's court, and Sgricci, of Florence, became known throughout Europe by giving specimens of his art in the early part of the century. The art is, however, dying out before the printing press and the communal school. The word is not uncommonly spelt *improvisatore* in English.

IM'PULSE. When a body rolls down a gently inclined plane we can see the gradual alterations of its velocity, and can readily admit that between the instants at which the body has two different velocities it takes in succession all intermediate velocities, or that the change of velocity is perfectly gradual. But when a body is violently struck, as in the case of a bat and a ball, we can see no gradations of velocity, but the ball appears to be at once altered from a state of rest into one of rapid motion without having passed through any of the intermediate states. In this case it is said to have received an impulse, which word must be interpreted to mean any cause by virtue of which velocity is communicated suddenly and without gradations.

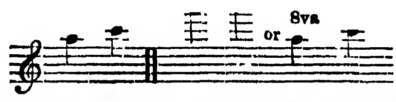
Though the term impulse may be of convenient application to cases of motion in which velocities are changed very rapidly, it must be remembered that the idea of absolutely instantaneous change of velocity is in no degree less absurd than that of a point which is in two different positions at the same instant of time. Impulse, then, must be considered as pressure which, beginning from nothing, increases so rapidly with the time as to produce large effects in an infinitesimally small fraction of a second.

It is to be remembered that there is nothing absurd in the idea of any change in the state of a body, provided that a time, no matter how small, be allowed for it to take place in. A cannon ball now at rest may, in the millionth part of a second, be imagined to have acquired a velocity such as it has when it issues from the mouth of the gun, provided only that a pressure be imagined sufficient to produce the effect. It is only the production of velocity in no time at all which must not be admitted; though it must be owned that the excessive smallness of the time in which some pressures produce a great effect makes us familiar with the notion of impulse which further inquiry shows us to be a mechanical impossibility, so long as the present laws of nature last.

IMPUL'SIVE INSAN'ITY is a form of mental disease in which the patient is apparently urged by a sudden uncontrollable morbid influence to acts of violence. Generally the approaches of mental disease are gradual and perceptible to ordinary observers, but sometimes the signs of such a disorder are so slight as to escape notice, and the attack comes almost as suddenly as a fit of epilepsy, to which it bears much resemblance. The acts of violence most frequently attempted are suicide and homicide, and in cases of the latter kind the accountability of the murderer for his actions is a point often very difficult to determine. This form of insanity need not, however, take a violent direction, and many instances are recorded in medical works where the impulses have merely led to the perpetration of acts of an absurd and ridiculous character.

IMPUTA'TION, a term derived from the New Testament and largely employed in the science of theology, where it is used to denote the transference of guilt or of merit. Thus in the Augustinian doctrine of original sin, afterwards more fully developed in the system of CALVINISM, it is maintained that the sin of Adam is imputed to all his descendants, and God is supposed to hold every man guilty because of the sin of the first parents of the race. In a similar way, when the forensic view of the atonement prevailed, it was held that in the sacrifice of Christ all the sins of the race were imputed to him, and that he undertook to satisfy the demands of divine justice on their account. Finally, it has been represented that the righteousness of Christ is imputed to believers, and they are not regarded in the divine mind for what they are in themselves, but are invested with the perfect righteousness of another. The use and abuse of this term affords an interesting study of the manner in which the minds of men are enslaved by words, and also of the curious self-confidence displayed by theologians in their efforts to explain the ineffable mysteries involved in the ways of God towards man.

IN ALT, IN ALTIS'SIMO. These are musical terms, Italian in origin, of which the first applies to notes for an octave above the treble stave, and the second to notes more than one octave above it. The illustration makes this clear—



A and C in alt (a'', c'''). A and C in altissimo (a''', c'''').

IN ANTIS. See ANTÆ.

IN CŒ'NA DOM'INI, one of the most famous of the papal bulls or decrees, getting its name from a rubric of Urban VIII. (1627) ordering its annual reading at the Lord's Supper (*cœna domini*) on Holy Thursday. It was read accordingly up till 1770, when Clement XIV. discontinued it.

The *In Cœna Domini* is a collection of extracts from various papal constitutions and bulls, forming altogether a general commination or summary of ecclesiastical censure and denunciation. It deals out excommunication with a liberal hand, not only in spiritual matters, as heresy, schism, &c., but also in mundane affairs, as attacks on the temporal rights of the church, &c. Further, it proceeds to condemn piracy, wrecking, forgery, and other purely secular crimes; and, in fact, so to interfere with the sovereign rights of countries that numbers of protests used annually to be issued by the various monarchs against this standing assumption of the church. This led to the eventual abandonment of the yearly publication.

IN COMMEN'DAM. See COMMENDAM.

IN PAR'TIBUS, short for *in partibus infidelium* (in heathen lands), a title given to Roman Catholic bishops of fictitious sees. The practice became very general in the times of the Crusades, when towns which had been Christian bishops' sees, founded in the early Crusades, were lost to the Christians later on, and the bishops were nevertheless appointed continually, as a standing reminder to Christendom and an expression of hope for better times. Meanwhile the prelates were set to other uses. For instance, in Great Britain Roman Catholic bishops *in partibus* ruled the Roman Catholic sees; the real bishop of Edinburgh being the titular Bishop of Limyra *in partibus*, &c., because it was felt that an English Roman Catholic hierarchy would not be tolerated. In fact, when the fiction of sees *in partibus* was felt to be worn out, and Roman Catholic prelates began cautiously to style themselves by the names of their actual English sees a violent anti-papal movement took place, culminating in the Ecclesiastical Titles Act of 1850. The Act proved abortive, and was repealed in 1874, and Roman Catholic bishops now freely use their actual titles.

INARCH'ING, or grafting by approach, is an operation in gardening performed when the stocks intended to be grafted, and the tree from which the graft is to be taken, stand so near together that their stems or branches may be bent and united. It is principally employed in raising camellias, oranges, and other hardy exotic trees. A portion of the stock, about 2 inches in length, is slit off;

then a small vertical notch is made in this slit; the branch of the tree to be inarched is slit off in the same manner, except that a tongue is left, which is inserted into the notch of the stock, so that the barks of both meet on each side. Bass is tied round, so as to keep them exactly in position, and the place is well clayed over to keep out the air. In this method of grafting, the scion is not separated from the tree until it is firmly united with the stock, nor is the head of the stock or branch that is grafted cut off until the same time. The operation is not performed so early in the season as other methods of grafting, but is usually undertaken in April when the sap is flowing. See GRAFTING.

INAUGURA'TION, a solemn opening ceremonial. The word is derived from the Latin *inauguratio*, the ceremony of the dedication of temples, &c., and also that of ascertaining whether some decree or election just passed was agreeable to the will of the gods by auguries taken by the state augurs in the prescribed manner. [See AUGUR.] As all the higher magistrates required inauguration, the word came to be synonymous with investment in office, and easily glided into the secondary meaning of an opening ceremony.

INCANDES'CENCE. This term refers to that property of bodies by which they give out light when raised to certain high temperatures, the quantity of light increasing with the temperature within certain limits. At first it is of a dingy red, or worm-red as it is sometimes called, then bright red, then an orange or yellow tint, and lastly white heat, when the light is painful to the eye. Pouillet's experiments placed the degree of incipient luminosity in the dark at about 900° Fahr.; but a dull red visible in daylight is nearly probably equal to 1290°; a full red heat, 1650°; an orange heat, 2000°; a white heat, 2400°; and the high white heat of a good wind furnace about 2700°. These remarks apply to bodies which can be raised to these high temperatures without changing their state. Most bodies are destroyed before they attain the temperature necessary for incandescence, and if heated in the air they inflame and undergo combustion. The beautiful incandescent electric lamps [see ELECTRIC LIGHTING] have their glowing filaments inclosed on this account in a glass globe exhausted of air and hermetically sealed. The thread of carbon which the intense heat of the modified electric current causes to glow at a white heat lasts in this way for months or years, though not thicker than a thin wire, but were it exposed to the air it would perish in an instant by combustion. The light of our ordinary illuminants, the flame of gas, of a wood match, or of a candle, is due not to combustion, but to incandescence. The heat generated by the true flame is so great that the particles of carbon not entering into chemical combination are raised to a glowing white heat. If air is mixed with gas the flame, as in the Bunsen burner, has plenty of oxygen, and the heat is increased by the greater completeness of combustion, but the light is almost destroyed. So with the flame of hydrogen, in which are few or no solid particles: it yields no incandescence—*i.e.* little light.

INCANTA'TION, a term used to denote that method of magic which was supposed to gain its efficacy from the utterance of a form of words by the magician. Such words were sometimes recited in a passionate manner, and the reciter worked himself into a state of frenzy; at other times they were cast into a rhythmical form, and then sung or chanted, while in some forms of superstition they were muttered in a low muffled voice. Unlike the utterances of prayer and supplication, in which appeal is made to a higher power, the incantation was supposed to *compel* the spirits invoked to answer questions or lend their aid at the bidding of the witch or wizard. Incantations seem to have been practised by most of the nations of antiquity, and they form an important part of the ceremonies practised by the medicine-men, devil-dancers, fetish-men, witch-doctors, exorcists, &c., which are found among the different savage nations of the present day. A belief in the efficacy of magical words in the form of spells, charms, &c., is often found prevailing among ignorant rustics in Christian countries and in some parts of the British Isles.

Incantations are still in use for curing dislocations and some diseases. In Chambers' "Popular Rhymes of Scotland," an account is given of the manner in which sprains are sought to be healed at the present day in the Shetland Isles. The operation is thus described: "When a person has received a sprain, it is customary to apply to an individual practised in casting the 'wresting thread.' This is a thread spun from black wool, on which are cast nine knots, and tied round a sprained leg or arm. During the time the operator is putting the thread round the affected limb he says the following charm, but in such a tone of voice as not to be heard by the bystanders, nor even by the person operated upon:—

> 'Our Lord rade, His foal's foot slade:
> Down he lighted. His foal's foot righted.
> Bone to bone, Sinew to sinew,
> Blood to blood, Flesh to flesh;
> Heal, in name of the Father, Son, and Holy Ghost.'"

INCARNA'TION (Lat. *in*, and *caro*, *carnis*, flesh), a term used in Christian theology to designate the union of the second person of the Trinity with the Son of the Virgin Mary, Jesus Christ. There has been much controversy from the earliest times as to the nature of this union; but by the more thoughtful of Christian theologians no explanation has been deemed possible. It is accepted as a fundamental doctrine by the majority of Christians, the chief exceptions being the Unitarians, who reject the doctrine of the Trinity, and the Swedenborgians, who have a peculiar doctrine of their own upon the matter. The conception of an incarnation of a deity in a human body is found as part of the religious systems of ancient Egypt, Persia, India, Greece, and many other nations of antiquity. The Hindus not only believe in several incarnations of Vishnu in the past, but also expect another in the near future.

IN'CENSE. The use of fragrant gums, woods, spices, &c., to give rise to a fragrant smoke for sanitary fumigations and in connection with public worship, dates from a very remote period of antiquity. It was burnt in immense quantities in the temple services of ancient Egypt, Assyria, India, Greece, and Rome, and it is still universally used throughout the East for the same purpose. In many places it is also used for domestic purposes as a source of refreshment, and the burning of incense forms part of the ritual observed at weddings, funerals, &c. Among the Hebrews the offering of incense formed an important part of the tabernacle and temple service, and minute directions are given in the Levitical laws as to its manufacture and use. It was to be compounded of equal weights of the perfumes stacte, onycha, galbanum, and pure frankincense, and its use for private purposes was strictly forbidden (Exod. xxx.) The sacred incense was burnt every morning at the trimming of the lamps, and every evening when they were lighted, and on the great day of atonement a handful was burnt by the high-priest in the most holy place. The reason of this last injunction is clear from Leviticus xvi. 13. The blood-offering had to be offered before the mercy-seat whereupon the Lord sat, between the cherubims of it; now no man shall see the Lord and live, therefore "he shall put the incense on the fire before the Lord, that the cloud of the incense may cover the mercy-seat that is upon the testimony, *so* that he die not." The object of burning incense in general was to provide a "sweet savour," a kind of symbol representing the burnt-offerings of more solemn and special occasions.

From Tertullian and other early writers down to St. Augustine it is evident that the use of incense in the

services of the Christian church was unknown during the first four centuries. Its introduction probably took place when the oppression of the Christians by the Roman government finally ceased, and the splendour both of churches and ritual began.

Incense is used in the Greek and Roman Catholic Churches, especially in connection with the eucharistic services. It chiefly symbolizes the ascent of prayer to God, the sweet odour of Christian virtue, and the zeal with which the faithful should be consumed. The use of incense was laid aside by the Anglican Church at the period of the Reformation; but it has been revived by the Ritualists, and in many of their churches it is regularly used at the communion service. It is not used by Protestant dissenters, and the practice has been condemned by many writers as being without warrant of Scripture and unsuited to the spirituality of Christian worship.

The ingredients used in the manufacture of modern incense vary according to the taste of the maker; but olibanum, benzoin, storax, aloes, cascarilla bark, cinnamon, and cloves are the materials chiefly employed.

IN'CEST is the name given to the marriage or sexual intercourse of persons within the Levitical degrees. In England it has not generally been treated as a crime, though during the Protectorate in the year 1650 incest and adultery were made capital offences. At the Restoration this law was not confirmed, and the offence was left to the coercion of the spiritual courts merely. All marriages, however, within the prohibited degrees are void. In Scotland incest is a crime punishable with death; and though it is improbable that this punishment would ever be inflicted, a sentence of penal servitude for life was passed for the offence in 1855.

INCH, a standard English measure, determined by the fact that at London, at the sea-level, a properly protected pendulum which makes an oscillation in a mean second (an average second) is 39·13983 inches long. The word is the same as *ounce* in its origin; for both of them are derived from the Latin *uncia*, the twelfth part of a pound (*as*) or of a foot (*pes*). As *uncia* was probably originally a small weight it may be connected with the Greek *ὄγκος*.

INCH, in the Scotch sense of *island*, as Inchcolm, Inchkeith, &c., is quite another word; it is a Gaelic word, from the same original Aryan stem as *ins* in the Latin *ins-ula*, an island. The Erse form is *innis*.

INCHBALD, MRS. ELIZABETH, actress, dramatic author, and novelist, was born 15th October, 1753. Losing her father in youth, she ran away at the age of sixteen to seek her fortune. After several adventures she obtained a place in a country theatre, and soon after married Mr. Inchbald, a respectable actor, much older than herself. Mr. and Mrs. Inchbald performed for four seasons in Edinburgh, and, after an engagement at York, went to France for a time. In 1779 Mr. Inchbald died at Leeds, and in the winter of 1780–81 Mrs. Inchbald played secondary parts at Covent Garden. She continued on the stage till 1789. She had begun to write dramatic pieces several years before her retirement from the stage; the first, a slight afterpiece, in 1784; and from that time till 1805 she wrote plays in rapid succession, producing nineteen in all, one of which, "Lovers' Vows," is an adaptation from Kotzebue. They gained for her the means not only of supporting herself, but of making a handsome allowance to an invalid sister, and of saving a considerable sum. Mrs. Inchbald's literary talents are best exhibited by her two novels, "A Simple Story," first published in 1791, and "Nature and Art," in 1796. She died on the 1st of August, 1821, at Kensington. She had written an account of her own life, for which she refused £1000, and in obedience to her will it was destroyed after her death; but her journal, kept regularly for many years, was preserved, and from it and her letters were written Mrs. Boaden's "Memoirs of Mrs. Inchbald" (1833).

IN'CIDENCE, ANGLE OF, the angle made by a straight line, lying in a vertical plane, and passing through any point of a line or surface, with the perpendicular to that line or surface drawn through the point in question. Thus, when A B is the perpendicular at the point B to a given line or plane C B D, the angle made with A B by any other straight line E B passing through the point B, namely the angle A B E, is the angle of incidence.

INCLINA'TION. The inclination of two lines is a phrase commonly used for the angle which they make with one another; thus two lines which make a very small angle are said to be at a very small inclination to each other.

INCLINA'TION or **DIP** of **MAGNETIC NEEDLE** is a property of the magnetic needle discovered in 1576 by Norman, a mathematical instrument maker, whereby it tends to dip downwards towards the north. He therefore constructed a dipping needle which could turn only in a vertical plane, and which is therefore the converse of the ordinary compass needle, which turns only in a horizontal plane. Thus tested, he found the dip at London to be 71° 50′. From observations of the variations of dip at various latitudes the surmise was found to be well-grounded that vertically as well as horizontally the needle was seeking to place itself in a line with the magnetic pole of the earth, and that consequently if the north magnetic pole could be reached by a ship the dipping needle would be found to stand vertically. But though the magnetic pole is 1000 miles away from the north pole, it is sufficiently near to make it a matter of difficulty to reach it. In 1831 Sir J. C. Ross succeeded in reaching it, and in proving the fact by the verticality of the needle. The magnetic north pole was then in Boothia Felix, just outside the arctic circle, N. lat. 75° 5′, and W. lon. 96° 46′. The magnetic south pole has been found by one observer in S. lat. 75° and E. lon. 138°; but others have observed that as it is approached two varieties of dip are observed, whence it seems possible that there may be two magnetic south poles or polar regions. In any case the north and south magnetic poles are not on the same diameter of the earth.

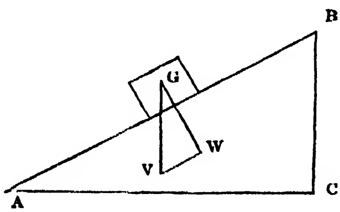
But though the earth is a magnet, as Gilbert of Colchester asserted as early as 1600 (or, we should now say, a *collection* of magnets with the same, or closely similar, poles), its magnetism varies. The variation of the declination of the needle (that is, its deviation from the true north) is elsewhere treated of [see DECLINATION], and it remains here to trace the variation of its inclination or dip. Taking 1880, the dip at Boothia Felix was of course 90° (vertical, being over the magnetic north pole); in St. Petersburg it was 70°, in London 67° 40′, in Paris 66°, in Berlin 64°. By thus taking a number of observations a series of lines of magnetic latitude may be constructed, along each of which the dip is the same for the whole line; such lines are called *isoclinic*, and answer to the parallels of latitude of the geographer, differing strongly from them in accuracy or concentricity. In England the isoclines cut across not W. to E., but W.S.W. to E.N.E.

As regards variation in time, we know from the first observation of Norman in 1576 that the dip at London was then 71° 50′. Another observation (of Gilbert's) in 1600 gives us a greater dip, 72°. In 1676 we get a still greater dip, 73° 30′, and the maximum is reached in 1720 at 74° 42′. Then the dip begins to fall off. In 1728 it was 72° 8′; in 1800, 70° 35′; in 1830, 69° 3′; in 1880, 67° 40′; in 1888 it is estimated that it will be 67° 25′.

But also there are minute daily variations, never more

than 10′ of arc, and due to the motion of the sun, the variation of the day being corrected by that of the night. Further, there are, from the same cause, seasonal variations, the dip being less in England during the four summer months than in the rest of the year.

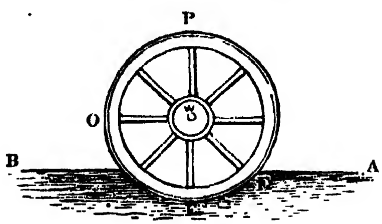
INCLINED PLANE, a plane surface making any angle with the horizon. A body placed on it is capable of being moved upwards along it with more facility than it can be raised in a vertical direction. The principle on which it constitutes a mechanical power was first introduced by Stevinus in the sixteenth century, and may be explained as follows:—Let A B represent a section of the plane, and G a section of the weight. Let G V represent the magnitude and direction of the weight, and draw G W and W V perpendicular and parallel to A B. Then, by the composition of forces, the pressure G V is equivalent to the two pressures G W and W V, of which the former is destroyed by the resistance of the plane, and the latter only acts to propel the heavy body down the plane. Now V W is to V G as B C is to A B; that is, a weight placed upon



an inclined plane is propelled down the plane by such a fraction of the whole pressure of the weight as the height of any section of the plane is of its length.

If, then, it were required to draw the heavy body G up the plane, any pressure exceeding V W would be sufficient for the purpose; and a pressure equal to V W, applied in the direction A B, would keep the weight at rest.

A practical application of the principle of the inclined plane may be given in the case of a cart stuck fast in yielding ground. Let the wheel be imbedded to a depth A B: suppose the cart moving towards A; then E being the lowest point, and F where it meets the surface, the space E F is an inclined plane to be ascended before the



cart can proceed. Now, the power of the horse is communicated through the trams to the centre W of the wheel, where it acts. But when men lend their aid, the most advantageous point at which their power can be applied is at or near P. When applied at or near O, as is sometimes done, much power is wasted in simply raising the load, without a corresponding advantage. In pushing behind the cart, as the force is all communicated to the centre of the wheel, it is not so efficaciously expended as at P.

The inclined plane is much employed for raising great weights through small heights, generally higher than in cases for which the lever is used. Flights of steps are uphill work made easy. The sagacity of horses drawing loads is displayed in the serpentine course they pursue when ascending steep roads. By this means they in effect divide the road into a series of inclined planes of less steepness than the road itself. This has the disadvantage of increasing the length of the plane and the time of action, but reduces the force which would be necessary to do the work by going directly forward upon the steeper ascent.

INCLOSURE. The term inclosure is applied to the inclosing and partitioning of lands in England and Wales, which are comprehended under the general name of commons or common lands; that is, lands in a state of nature or waste, of which individuals have not the severalty. "Commonable" lands are those lands which during a part of the year are in severalty, that is, occupied severally by individuals as their own, to the exclusion for the time of other people. See COMMONS.

Since 1801, and more especially since 1845, special facilities have been given for the general inclosure and allotment of commons, or part of them, for the purpose of cultivation. Such inclosures were prompted partly by the exigencies of the French War, and partly with the object of securing the increase of home-grown grain, in order to render Great Britain independent of foreign countries for its food supply. Up to 1845 inclosures were made by means of private bills; but in that year inclosure commissioners were appointed, and in each subsequent year an Inclosure Bill was, as a matter of course, passed, to confirm the various schemes of inclosure approved by the commissioners during the previous year.

INCOMBUSTIBLE FABRICS. Owing to the great number of deaths which of late years have resulted from ignition of the clothing of women and children, various experiments have been made with the view of rendering linen, calico, and muslin garments incombustible. Many chemical preparations possess this property; but the two most recommended as being cheap, easily applied, and not liable to injure the colour of the material, are sulphate of ammonia and tungstate of soda. Of the first, a solution containing 7 per cent. of the crystalline salt is a perfect preservative; of the latter, a proportion of 4 ounces of tungstate of soda to a drachm of phosphate of soda, dissolved in a pint of water, will be found efficacious. The fabric should be dipped in the solution, or wetted all over with it, before ironing it.

INCOME AND OUTCOME OF THE BODY. Under this head physiologists group a number of most interesting experiments and calculations upon the balance between the food supplied to the body and the waste of the tissues and excreta discharged from it.

The *income* of the body consists of food, drink, and air. A careful approximation gives this result for twenty-four hours:—

	Grains.
Solid food (chemically dry), ...	8,000
Water (in solid food, or as drink), . . .	37,650
Oxygen, ...	13,000
(About 8⅓ lbs.)	58,650

The *outcome* of the body, or the bodily expenditure, passes off by the kidneys, the lungs, the skin, and the intestines, in the following proportions:—

	Grains.
Kidneys, ...	24,100
Lungs, ...	20,000
Skin, ...	11,750
Intestines, ...	2,800
	58,650

Of course so exact a balance can never occur. Sometimes the man gains weight and sometimes he loses weight; but this is a very near average for a healthy man of moderate stature, strength, and appetite.

That it does not represent the stages below manhood is

manifest from the fact that at birth we weigh but a twentieth and measure less than a third of our future weight and height. Therefore a large excess of income over outcome is found in these earlier years. The reverse, but to an incomparably less degree, takes place as old age comes on; the waste of the body is here rather greater than its income.

In measuring the dietetic value of foods by the income and outcome of the body, a class of experiments of incalculable value, to which a great amount of time and attention is now devoted by our physiologists, care must be taken in estimating the fæces; for it is found that a very large part, indeed by far the larger part, of the fæces is composed of undigested food. That is to say, we give our bodies the labour of passing more food unchanged through the alimentary canal than the quantity which suffers change and which is really required for the wear and tear of the system; or in other words, if we ate and drank half as much as we do, we should still have food to spare in the body.

INCOME TAX. In order to replenish a failing exchequer and remove the fetters which weighed on British commerce in his day, Sir Robert Peel proposed and carried an income tax in 1842. It was passed for only three years, but it has survived till the present, and at every emergency it has adapted itself to the national wants with unfailing elasticity. It was at first fixed at 7*d.* in the pound on all incomes of £150 and upwards, and was limited in its incidence to Great Britain. No change took place with respect to the rate or incidence of the tax for eleven years, and the decade terminating with 1852–53 produced an average yearly revenue of £5,471,000. From this average no individual year widely diverged.

The second period of the tax may be said to have begun with 1853–54. During this time Ireland was brought under the tax, and it was carried down to all incomes of £100; but a lower rate was fixed for incomes of £100 and under £150, as shown in the annexed table:—

NET RECEIPTS FROM INCOME AND PROPERTY TAX IN GREAT BRITAIN AND IRELAND FOR THE TEN YEARS FROM 1854 TO 1863.

Financial Year of the Second Period.	Annual Receipts.	Rate per £ on Incomes of	
		£150 and upwards.	£100 and under £150
	£	s. d.	s. d.
1853–1854	5,730,000	0 7	0 5
1854–1855	10,922,000	1 2	0 10
1855–1856	15,159,000	1 4	0 11½
1856–1857	16,051,000	1 4	0 11½
1857–1858	11,896,000	0 7	0 5
1858–1859	6,610,000	0 7	0 5
1859–1860	9,666,000	0 9	0 6½
1860–1861	10,957,000	0 10	0 7
1861–1862	10,471,000	0 9	0 6
1862–1863	10,483,000	0 9	0 6

We have spoken of the tax as one of unfailing elasticity, and the above figures justify the assertion. In 1854–55 almost twice as much was raised by it as in the previous year; and 1855–56 and 1856–57 were each about 50 per cent. above 1854–55. The second period lasted ten years; the third commenced with 1863-64. No change took place in the area over which the tax was incident, but persons at the lower end of the scale had an abatement made to them in respect first of £60, then of £80, and finally of £120 of their income, which they were to enjoy untaxed. In 1876 the important alteration was made of exempting all incomes under £150 per annum from the tax, and of allowing an abatement of £120 on all incomes under £400 per annum. The rate was in 1878 increased to 5*d.*, but the same incidence was retained, and has been continued ever since. In 1880 it was increased to 6*d.* to provide for the deficiency caused by the transfer of the excise duty from malt to beer in the first year of its operation. It was reduced to 5*d.* in 1881, but raised to 6½*d.* in 1882 to provide for the cost of the Egyptian expedition. It was again reduced to 5*d.* in 1883, but increased to 6*d.* in the autumn session of 1884.

NET RECEIPTS FROM INCOME AND PROPERTY TAX, 1864–1884.

Financial Year of the Third Period.	Annual Receipts.	Rate per £.
	£	s. d.
1863–1864	9,102,000	0 7
1864–1865	7,986,000	0 6
1865–1866	6,322,000	0 4
1866–1867	5,637,000	0 4
1867–1868	6,184,000	0 5
1868–1869	8,618,000	0 6
1869–1870	10,044,000	0 5
1870–1871	6,350,000	0 4
1871–1872	9,084,000	0 6
1872–1873	7,500,000	0 4
1873–1874	5,691,000	0 3
1874–1875	4,306,000	0 2
1875–1876	4,109,000	0 2
1876–1877	5,280,000	0 3
1877–1878	5,820,000	0 3
1878–1879	8,710,000	0 5
1879 1880	9,230,000	0 5
1880–1881	10,650,000	0 6
1881–1882	9,945,000	0 5
1882–1883	11,900,000	0 6½
1883–1884	10,718,000	0 5
1884–1885	11,922,770	0 6
1885–1886	15,247,312	0 8

The most striking feature of the tax is its constantly increasing productiveness. In 1842 the tax of 7*d.* yielded £5,607,798, being much less than £1,000,000 for each 1*d.* In 1858 a rate of 1*d.* produced £1,129,500; in 1870 each 1*d.* produced £1,500,000, and it now yields nearly £2,000,000. So much for the growth of the wealth of the country within recent years. In 1797, when Pitt first imposed the tax, the annual amount on which it was assessed was only £100,000,000; in 1815 it had increased to £178,000,000; in 1842, when the tax was re-imposed by Sir R. Peel, it was £251,000,000. The assessment in 1884 was made on over £600,000,000.

IN'CREMENT and **DE'CREMENT.** When two quantities are considered together, one of which is greater or less than the second, the latter is said to be the former with an increment or decrement. In the older English writings the calculus of difference is called the method of increments.

INCRE'TIONARY NOD'ULES are those in which the summits of the crystals forming the concentric layers are turned inwards, showing that they were formed from without inwards by the deposition of material by percolating mineral waters; they are to be distinguished from concretions which are formed concentrically outwards. They are frequently hollow in the interior. The AGATE is a familiar example; others are abundant in the amygdaloids of volcanic rocks.

INCUBA'TION, in birds, is the act of sitting on the eggs till hatched. In nearly all birds incubation is performed by the female alone, or with the assistance of the male in some cases. Among the ostriches, emus, and other

members of the order Struthiones, the male alone takes upon himself the duty of incubating the eggs; and a similar habit is thought to obtain in certain of the wading birds, as the godwits and the dotterel. The period of incubation varies from two to six or seven weeks. Most of our smaller passerine birds hatch their young brood in about thirteen days. In the domestic fowl the eggs are hatched generally in twenty-one days. In the swan the period of incubation is as much as six weeks. Some birds begin to sit after laying the first egg or pair of eggs. In the case of owls it has been observed that the female, after hatching out the first two eggs, often abandons incubation altogether, the subsequent eggs being hatched by the warmth of the bodies of the young owlets. In the mound-birds (Megapodidæ) of Australia neither sex sits upon the eggs, but the birds deposit them in mounds of decaying vegetable matter, where they are hatched by the warmth caused by the fermentation of the mass. For artificial hatching see POULTRY.

INCUBA'TION OF DISEASE. It has been observed in connection with numerous diseases that an interval, which has been divided into two stages or periods, the latent and the invading, invariably elapses between the exposure to infection and the appearance of the disease. During the latent period, though certain changes must be going on within the system, there are few or no symptoms that can be observed; but such symptoms become manifest during the second period, and the patient is said to be sickening for the complaint with which he has been infected. The period of incubation varies in the different classes of infectious disease, being much longer in some than in others, and it differs, though to a less degree, in each particular form of disease. In influenza and cholera it is very short and is reckoned by hours, though in the latter disease it is sometimes extended to four or even five days. In cases of scarlet fever, diphtheria, and yellow fever the period has been found to extend from two or three, to six, seven, or eight days, while smallpox has a period generally of fourteen days, and chicken-pox, measles, and mumps vary from about twelve days to three weeks. Typhoid fever seems to take about eleven or twelve days to develop, and the influence of the malaria given off in some marshy districts is often felt two or three weeks after exposure. In particular forms of disease the period is influenced by the amount of the poison imbibed by the patient, his own peculiarities of constitution, and also by the manner in which the virus was introduced into his system. It is now generally believed that the forms of infectious disease referred to, with many others, such as plague, rabies, dengue, &c., are conveyed by means of living germs, which develop and multiply in the body into which they are introduced, each specific disease having its peculiar germ and microbe. See BACTERIA.

INCUM'BENT is the name given in England and Ireland to a person holding an ecclesiastical benefice. This term is not used in Scotland.

INCUNAB'ULA (Lat., swaddling clothes) are very early printed books; the term is not used for books later than 1500. The usual explanation is that such works are, as it were, the infancy of printing, its limbs still clogged by swaddling clothes. They are excessively rare, and therefore costly; but in general not really valuable except to the historian of printing. A few early editions of the classics are, however, of great value among the incunabula, because they were taken from MSS. not now to be found. The total number of works produced in this period is generally taken as 20,000, the issues of each book being exceedingly limited, and the copies now remaining of course far fewer still. Many are known by a single copy only. Hain's "Repertory of Printed Books up to the year MD." (1500) is the standard authority (Stuttgart, 1838); Skeen's "Early Typography" (Ceylon, 1872), and Blades' "Caxton" (London, 1877), are more recent works. A fine facsimile of the original edition (1489) of Caxton's "Statutes of Henry VII." by Rae, was produced in 1869 (London, 4to), and a fairly accurate type-printed facsimile of Caxton's first English book, the "Game and Play of the Chesse" (1476), by Figgins in 1878 (London, 4to). These are easily accessible, and give a good idea of incunabula.

IN'DENT is a name, not now so commonly used as formerly, given to orders or contracts for merchandise or supplies in cases requiring more than ordinary precautions. For instance, orders from foreign countries, which naturally bear certain conditions as to price, time, &c., bear the name of *indents*. The term originated (as in the kindred legal term INDENTURE) from such orders having a waved or *indented* edge where they had been cut from a counterfoil, so as to afford means of detecting forgery or fraud.

INDEN'TURE. When a deed is made by more than one party, there are (or used to be) as many copies as there are parties to it, and each copy is cut off by an indented line (formerly in acute angles, *instar dentium*, like the teeth of a saw, but at present a waving line) so that its top or side should tally or correspond with the other—which deed so made is called an indenture. The waving edge is still retained, even if no copies are made beyond the original; but it is needless to say that the copies, when there are any, are not all written on one sheet. The term is somewhat specially applied to an agreement between an apprentice and his master. See DEED.

INDEPENDENTS. See CONGREGATIONALISM.

INDETER'MINATE EQUATIONS, in algebra, are those which involve two unknown quantities, one equation being given; or if two equations be given and three unknown quantities, these equations would be also indeterminate. The meaning of the term is that the number of solutions is infinite. Nevertheless in practice, as, for instance, when negative values or fractional values are inadmissible, such problems are readily solvable. The usual method is by the introduction of a supposititious third quantity, and the statement of the values of the unknowns in terms of this quantity; numerical values being then applied to the supposititious quantity the various solutions of the equation may be readily obtained. An example will make this clearer.

Let the question be: With how many combinations of florins and half-crowns could you pay *£5?*

Here let x be the number of florins in any given combination and y the number of half-crowns. Now $4x+5y$ evidently would give the total number of sixpences, which we know to be 200 for all combinations alike. Thus we get our equation $4x+5y=200$. This is upon the face of it indeterminate, for we have no other equation formable from the question, and here is only one equation from which to find out the values of two unknown quantities.

Divide by 4, then (1) $x+y+\frac{1}{4}y=50$. Let $\frac{1}{4}y=t$, then $y=4t$. But putting $4t$ for y in (1), then $x+5t=50$, or $x=55-5t$. Let $t=0$; then $x=50$, $y=0$; and this tallies with what we know, for 50 florins make up £5 without leaving room for any half-crowns whatever. So if $t=1$, x (florins) $=45$, and y (half-crowns) $=4$; if $t=2$, then $x=40$, and $y=8$; if $t=3$, then $x=35$, and $y=12$; and so on till if $t=9$, then $x=5$, and $y=36$, 5 florins and 36 half-crowns. If we put $t=10$, then $x=0$, and $y=40$, which is accurate, for 40 half-crowns make up £5. Exclusive of all half-crowns or all florins we have nine values for t, and nine only, because in this case only integral values are in the nature of things admissible. Nine combinations of the required nature are therefore all that can be made.

It is found that equations of the form $ax+by=c$ (the form of that above, where a, b, and c are any given values) yield only a limited number of positive integral solutions; whereas equations of the form $ax-by=c$ yield an

unlimited number of positive integral solutions. If all solutions are admissible then both classes of equations yield an infinite number of solutions. If, however, a and b have a common factor not common to c, then no integral solution can be obtained; for instance, $3x + 6y = 71$ would give no integral value whatever, because 3, the factor of 3 and 6, is not a factor of 71.

INDEX. The value of a good index is only discovered by the trouble caused by the want of one. Without an index, looking for a particular passage in a large book is like searching for a needle in a pottle of hay. Furthermore, a bad index, with all the matter classified under wrong heads where no one thinks of looking for it, though it is better than nothing, is a very great source of annoyance. Consequently in 1878 a number of literary men, the principal librarians of course at their head, founded an *Index Society* in London, with the express view of teaching people on what principles to construct an index, and of promoting the construction of first-class indices to standard works and collections. The publications of the society are most valuable, from the highly interesting opening volume of Mr. Wheatley, "What is an Index?" (London, 1878), onwards to the present day.

The highly valuable index of Palmer to the *Times* newspaper from 1862, published quarterly, is not quite so well classified as one could wish, but is of immense value. In fact, for contemporary history it is practically indispensable. Another work of even greater research has brought glory to American bibliography; this is Poole's "Index to Periodical Literature," embracing all the principal quarterly magazines, &c., in its scope. It is a bulky large octavo of 1400 pages (London, 1883), and occupied Dr. Poole and his assistants for six years, although the nucleus of it, also by Poole, was of many years' standing. This has at once rendered hundreds of practically useless old numbers of magazines useful and valuable.

INDEX or **EXPONENT** is the name in algebra of the figure set above a quantity on its right-hand side to denote its *power*. If there is no index the quantity states its own value, or the index may be said to be 1. Thus a is the same as a^1; a^2 is the second *power* of a, or a multiplied by a; a^4 is the fourth power of a, or a multiplied by itself thrice running, $a \times a \times a \times a$, and is read a to the fourth. For fractional and negative indices, &c., see INDICES, THEORY OF. See also SURDS.

IN'DEX LIBRO'RUM PROHIBITO'RUM, or, as it is more usually called, the *Index Expurgatorius*, is the official title of a list of those books the reading of which is prohibited to all Roman Catholics. The practice of destroying and forbidding the study of certain books in order to suppress teaching regarded as dangerous is not, however, of Catholic or even Christian origin, for during more than one of the persecutions of the Christian Church edicts were issued ordering all Christian books to be given up and burned. The earliest known instance of the exercise of the authority of the church in this direction is in connection with the writings of Arius, and the earliest list of proscribed books issued under the pope's authority is one of uncertain date, sometimes assigned to Pope Gelasius, 494. From that period, during the whole of the middle ages, it was customary for lists of forbidden books to be issued under the authority of local synods or of the popes. When the Roman Inquisition was organized by a bull of Paul III. in 1542, the suppression of heretical literature formed an important part of its duties, and under its influence a list of prohibited books was issued by the senate of Lucca in 1545. In 1559 Paul IV. published what may be regarded as the first Roman Index in the modern use of the term, and the Council of Trent in its eighteenth session appointed a commission to consider the best means of suppressing heretical and hurtful literature. The commission reported to the council, and the result of its labours was placed in the hands of the pope, a second Index being issued under Pius V. in 1564. The rules of Paul IV. were afterwards modified and enlarged by Clement VIII., Sixtus V., Alexander VII., and Benedict XIV.

INDEX, CONGREGATION OF THE. Additions to the list of prohibited books have been made from time to time by the Roman Congregation of the Index, which consists of four cardinals and nine consultors. The master of the Vatican must always be one of the censors, and this office is limited to the Dominican order.

INDEX OF REFRACTION, the ratio between the sines of the incident and refracted angle when a ray of light passes from one medium to another and is refracted. It varies with the media; the index of refraction for air to water is $\frac{4}{3}$ (and of course for water to air it is $\frac{3}{4}$); and for glass to air $\frac{3}{2}$ (for air to glass $\frac{2}{3}$), and so on. See LIGHT.

INDIA, a vast country, forming the great central promontory of Southern Asia, remarkable alike for its magnificent scenery and rich natural productions, its early civilization and wonderful antiquities, as well as for its modern history. From the earliest historical period it has been the object of desire to conquering peoples, and few facts in the annals of nations are more surprising than the rapid subjection of its native empires and states, populous and once powerful, to British authority and influence, effected by a company of English traders, whose first visit to the land dates no further back than the beginning of the seventeenth century, and whose means were long limited to a handful of ships, forts, and factories.

The name itself is derived from the river Indus, which waters the western extremity of the country. Under the appellation of *India beyond the Ganges*, some writers have comprised the whole group of countries lying between the Bay of Bengal and the Chinese Sea. In the early part of the fifteenth century India comprehended nearly the same portion of the globe as that on which was vaguely bestowed the appellation of *East Indies*, the islands of the Indian Archipelago being included. The modern name *Hindostan* or *Hindust'han*, is a Persian appellation; and if, as some regard it, composed of the words *hindu*, black or swarthy, and *stahn*, a place, signifies the black or swarthy country. It has been supposed, again, that the term *Sind'hu*, signifying in the ancient Indian language the ocean, was originally given to the largest river of India; whence the Persians called the country separated from them by that river *Sind'hust'han*, or *Hindust'han*, *i.e.* the Sindian or Indian country, the substitution of *h* for *s* being common in the early languages of this region of the globe.

In general outline India forms a great irregular triangle, stretching southwards from Asia into the sea. Its northern base rests upon the Himalayan ranges; the chief part of its western side is washed by the Arabian Sea, and the chief part of its eastern side by the Bay of Bengal. It extends from 8° to 35° N. lat.; that is to say, from the hottest region of the equator to far within the temperate zone. The capital, Calcutta, lies in 88° E. lon., so that when the sun sets at six o'clock there, it is just past midday in England. The length of India from north to south, and its greatest breadth from east to west, are each about 1900 miles; but the triangle tapers with a pear-shaped curve to a point at Cape Comorin, its southern extremity. To this compact dominion there has been added, under the name of British Burma, the strip of country on the eastern shore of the Bay of Bengal. The whole territory thus described contains 1,377,540 square miles and 253,941,309 inhabitants. India, therefore, has an area and a population about equal to the area and population of the whole of Europe less Russia. In the present work articles will be found on each of the provinces into which India is divided, and on many of the larger towns and rivers, as well as upon Brahmanism and Buddhism. In this article, therefore, these subjects will only be referred to sufficiently to

give completeness to our review of the geographical, political, and social condition of India as a whole.

Boundaries and Physical Features.—Some idea of the great extent of India may be formed if it be conceived that from the line of the Himalayas southward to its extreme cape on the Indian Ocean, India occupies a space more than fifteen times as large as our island of Britain; a journey across it from north to south, or from east to west, would require half a year if one travelled 10 miles every day. The Himalayas are as distant from Cape Comorin as Iceland is from Spain.

The natural landward boundaries of this vast region are the range of the Himalayas on the north, forming the steep southern edge of the plateau of Tibet; on the north-west the Suliman Mountains, the edge of the plateau of Afghanistan and Baluchistan, where it descends to the plains of the Indus; and on the east the heights of southern Assam, dividing the drainage of the Brahmaputra from that of the valley of the Irawaddi, in Burma. From the mouths of the Indus on the west, and of the Brahmaputra and Ganges on the east, the south-west or Malabar coast next to the Arabian Sea, and the south-east or Coromandel shores of the Bay of Bengal, inclining towards the same point, meet at Cape Comorin. The landward and seaward borders have each nearly about the same length, and it is remarkable that just as the approaches to India from all parts of inner Asia must be made by descending difficult mountain passes, so its straight surf-beaten coasts, notwithstanding their length, are deficient in good harbours, and often dangerous to those attempting to land on them.

The empire included within these boundaries is rich in variety of scenery and climate, from the highest mountains in the world to vast river deltas raised only a few inches above the level of the sea. It forms a continent rather than a country. But if the whole could be viewed from a sufficient elevation, we should find that India consists of three separate and well-defined tracts. The first includes the lofty Himalaya Mountains, which shut it out from the rest of Asia, and which, although for the most part beyond the British frontier, form an overruling factor in the physical geography of Northern India. The second region stretches southwards from the base of the Himalayas, and comprises the plains of the great rivers which issue from them. They stretch across the entire width of the country, and are frequently referred to as the Great Plain of Northern India. The third region slopes upward again from the edge of the river plains, and consists of a high three-sided table-land, supported by the Vindhya Mountains on the north, and by the Eastern and Western Ghats, which run down the coast on either side till they meet at a point near Cape Comorin. The interior three-sided table-land thus inclosed is dotted with peaks and ranges, broken by river valleys, and interspersed by broad level uplands. It comprises the Deccan or southern half of the peninsula.

The first of the three regions is the Himalaya Mountains and their offshoots to the southward. The Himalayas—literally, the "dwelling-place of snow," from the Sanskrit *hima*, frost (Latin, *hiems*, winter), and *alaya*, a house—consist of a system of stupendous ranges, the loftiest in the world. They are the *Emodus* or *Imaus* of the Greek geographers, and extend in the shape of a scimitar, with its edge facing southwards, for a distance of 1500 miles along the northern frontier of India. At the north-eastern angle of that frontier the Dihong River, the connecting link between the Sanpu of Tibet and the Brahmaputra of Assam, bursts through the main axis of the Himalayas. At the opposite or north-western angle, the Indus in like manner pierces the mountains and turns southwards on its course through the Punjab. The Himalayas culminate near their centre in Kanchinjinga, 28,176 feet, and Mount Everest, 29,002, or nearly 5½ miles high, the latter being the loftiest measured peak in the world. The higher ranges between Tibet and India are crowned with perpetual snow; while vast glaciers, one of which is known to be 60 miles in length, slowly move their masses of ice downwards to the valleys.

The Himalayas not only form a double wall along the north of India, but at both their eastern and western extremities send out ranges to the southwards, which protect its north-eastern and north-western frontiers. On the north-east those offshoots, under the name of the Naga and Patkoi mountains, &c., form a barrier between the civilized British districts and the wild tribes of Upper Burma. The southern continuations of these ranges, known as the Yomas, separate British from independent Burma, and are crossed by passes, the most historic of which, the Aeng or An, rises to 4668 feet, with gradients of 472 feet to the mile. On the opposite or north-western frontier of India, the mountainous offshoots run down the entire length of the British boundaries from the Himalayas to the sea. As they proceed southwards, their best marked ranges are in turn known as the Sufed Koh, the Suliman, and the Hala mountains. These massive barriers have peaks of great height, culminating in the Takht-i-Suliman, or Throne of Solomon, 11,317 feet above the level of the sea. But the mountain wall is pierced at the corner, where it strikes southwards from the Himalayas by an opening through which the Indus River flows into India. An adjacent opening, the Khyber Pass (rising to 3373 feet), with the Kurrum Pass to the south of it, the Gwalari Pass near Dera Ghazi Khan, and the famous Bolan Pass (5800 feet at top) still further south, furnish the gateways between India and Afghanistan. The Hala, Brahui, and Pab mountains form the southern hilly offshoots between India and Baluchistan, and have a much less elevation.

The Himalayas, while thus standing as a rampart around the northern frontier of India, collect and store up water for the tropical plains below. Throughout the summer vast quantities of water are exhaled from the Indian Ocean. This moisture gathers into vapour and is borne northward by the monsoon or regular wind, which sets in from the south in the month of June. The monsoon carries the masses of clouds northwards across India, and thus forms the "rainy season," on which agriculture so critically depends. But large quantities of the moisture do not fall as rain in passing over the hot plains. This vast residue is eventually dashed against the Himalayas. Their lofty double walls stop its further progress northwards, and it either descends in rain on their outer slopes, or is frozen into snow in its attempt to cross their inner heights. Very little gets beyond them; so that while their southern spurs receive the largest measured rainfall in the world, and pour it down the Indian rivers, the great plateau of Tibet on the north of the double wall gets scarcely any rainfall. At Chena-Poonjee, where the monsoon first strikes the hills in Assam, 368 inches of rain fall annually. The outer slopes of the Himalayas swell the Indian rivers by their torrents during these excessive rains; their inner ranges and heights store up the rainfall in the shape of snow, and thus form a vast reservoir for the steady supply of the northern streams throughout the year. The descent to the plains of India is not by a uniform slope, but by a series of subordinate or sub-Himalayan ranges, and from the exterior ridges of those the distance to the stupendous heights of the great northern range is about 80 miles. On the lower slopes to the south are situated numerous sanitaria for the troops, and from here the aspect of the great mountains in the distance is often not more magnificent than extraordinary, owing to clouds completely hiding the lower slopes from sight. Hence the peaks appear projected against the clear blue sky without a visible solid basement, either wholly silvered with snow, or partly patched and tipped, or, where the inclination is

too precipitous for snow to find a resting-place, their naked pyramidal masses of gneiss and granite are exhibited.

The Himalayas are really a mountain region rather than a mountain range, their general character being a perpetual succession of vast ridges with narrow intervening glens and open valleys, the latter forming the distinct sub-Himalayan countries of Cashmere, Gurhwal, Kumaon, Nepal, Sikkim, and Bhutan, all of which are hilly regions with valleys of varying extent. Descending the Siwalik Hills, the last of the Himalayan ridges on the side of India, we pass through a belt of dry forest, and then come to the *Terai* or great Indian swamps, a dark stretch of lowland covered with great forest trees and dense fever-breeding jungle, inhabited only by wild beasts and by the Taroos, a squalid feebly-formed race, whose existence is a standing physiological miracle. It forms a marked barrier between the races of the sub-Himalayan countries and those inhabiting the plains, and is not only a dividing wall between the cool uplands and the hot lowlands of India, but is a narrow strip, the people on one side of which are shut off, owing to their difference of language, from those living on the other side.

Southward from the Terai and the bases of the Himalayas lie the great plains of Northern India, which form the second of the three geographical regions into which the country may be divided. They extend from the Bay of Bengal on the east to the Afghan frontier and the Arabian Sea on the west, and contain the richest and most densely crowded provinces of the empire. One set of invaders after another have from prehistoric times entered by the passes on the north-western frontiers. They all followed the courses of the rivers, and pushed the earlier comers southwards before them towards the sea. No less than 150,000,000 people now live on and around these river-plains in the provinces of Bengal, Assam, the North-western Provinces, Oudh, the Punjab, Sind, Rajputana, and other native states. The western or Indus region has generally a dry and bare character, with a soil of clay and sand almost without stones. Here are the fine steppe-like *Doabs* or "two waters," *i.e.* the spaces inclosed between the great rivers of the Punjab, between the fertile borders of the rivers, affording boundless grazing ground for camels, cattle, buffaloes, sheep, and goats; further south the great Indian desert, or *Thar*, covered with a succession of wave-like sandy ridges, occupies the greater part of Rajputana. It is an expanse 400 miles long and 100 broad, covered with sandhills, among which crops of grain can only be grown in a very few spots in the vicinity of the rivers or after the rains. In the Hindu records it is described as the "Valley of Death." Men cannot cross it on foot, and even the horse and camel often succumb before they can pass its dreary wastes of sand, which, like the moist Terai on the north, has ever acted as a dividing line between the races on either side of it. Beyond this, about the lower Indus, come the dusty plains of Sind, and on the coast the strange tract called the Rann (or Runn) of Cutch—a level plain 150 miles in length, in which vegetation is totally absent; it forms during the greater part of the year a firm level plain of earth saturated with salt, on which the troops of horses and camels in passing make scarcely any impression. So devoid of all landmarks is it that travellers and caravans are sometimes lost. During the south-west monsoon, however, high tides flow over it, and cover it with water to the depth of 1 or 2 feet. The eastern wing of the great plain watered by the Ganges and Brahmaputra and their many tributaries, is unlike the western in having everywhere a richly fertile alluvial soil, in being everywhere highly cultivated, yielding great crops of sugar-cane, cotton and indigo, rice and wheat, opium, tobacco, and hemp, and supporting a dense population. At the head of the Bay of Bengal this wing of the plain terminates in the great group of marshy islands called the *Sundarbans* (or Sunderbunds), which form the vast delta of the Ganges. These are separated by a multitude of narrow channels of brackish and salt water, and all are overgrown by low woods and jungle, sheltering tigers, wild buffaloes, wild swine, deer, and monkeys.

Southward of the northern plains the land begins to rise again, and we come to the third great general division of India, namely, the three-sided table-land which covers the southern half or more strictly peninsular portion of India. This tract, known as the Deccan (Dakshin, literally "the south"), comprises the Central Provinces, Berar, Madras, Bombay, Mysore, with the native territories of the Nizam, Sindhia, Holkar, and other feudatory states. It had in 1881 an aggregate population of about 100,000,000. The Deccan in its local acceptation is restricted to the high tract between the Nerbudda and the Kistna Rivers; but it is popularly understood to include the whole of the country southwards of the Vindhyas. These are a confused series of distinct ranges running with a general direction of east to west, and known in the aggregate as the Vindhya Mountains. Two sacred peaks stand as outposts in the extreme east and west, with a succession of ranges stretching 800 miles between. At the western extremity, Mount Abu, famous for its exquisite Jain temples, rises as a solitary outlier of the Aravulli Hills, 5650 feet above the Rajputana plains, like an island out of the sea. On the extreme east, Mount Parasnath, sacred also to Jain rites, rises to 4400 feet above the level of the Ganges plain. Between these the various ranges of the Vindhyas, the Aravulli, Satpura, &c., from 1500 to over 4000 feet high, form as it were the northern wall and buttresses which support the central table-land. Now pierced by road and railway, they stood in former times as a barrier of mountain and jungle between Northern and Southern India, and formed one of the main difficulties in welding the whole into an empire. They consist of vast masses of forests, ridges, and peaks, broken by cultivated valleys and broad high-lying plains.

The other two sides of the elevated southern triangle are known as the Eastern and Western Ghats. These chains start southwards from the eastern and western extremities of the Vindhyas, and run along the eastern and western coasts of India. The name *Ghat* or *Ghaut* (from *ghat*, a landing-place, ford, or pass) was originally applied by the natives to the passes in the outer slopes of the ranges, which run parallel with the two coasts of the southern portion of the great promontory of India inclosing the Deccan, and which had to be ascended to reach the high interior country from the coast; but from this the name has been transferred to the ranges or outer edges of the table-land themselves.

The Western Ghats, about 800 miles in length, clothed with magnificent teak forests, form by far the boldest and most continuous escarpment of the Deccan plateau, ascending abruptly from a low base, generally at a distance of about 30 miles from the sea. Beginning with a height of about 2000 feet immediately south of the Tapti River, their elevation increases southward to 4700 feet, and attains a maximum of nearly 7000 feet, with grand and rugged outline and precipitous granite peaks in the south; there they unite with the group of the Neilgherries or Blue Mountains, which culminate in the peak of Dodabetta, 8760 feet above the sea. The Eastern Ghats differ from the western in being much lower, in rising at a much greater distance from the coast of the Bay of Bengal, and with a gentle slope giving access by wide openings to the interior. Their average height is about 1500 feet above the sea, and the highest point, near Madras, is about 3000. The Deccan plateau between these supporting buttresses has thus a gradual eastward slope, and is characterized by undulating treeless plains, ridges, and isolated flat-topped

hills capped with basalt. These rocky heights, called *droogs*, have been used from the earliest times as hill-forts, and the British now garrison many of them, while some are used as sanitaria. Other large portions of the plateau are covered with jungle, often overgrowing the ruins of former towns and temples, but there is no very considerable extent of forest; where cultivated it yields cotton, wheat, and oil-seeds in abundance, and the date-palm and palmyra are found everywhere.

Between the Eastern Ghats and the sea, reaching back from the Coromandel coast for about 50 miles, lies the extensive maritime plain of the Karnatak (Carnatic), a term derived from the ancient Hindu kingdom, Karnata, in which the Kanara language was spoken. This was the theatre of the contests between France and Britain for supremacy in India. The soil of this plain proves abundantly fertile when it is watered, but there are few streams, and a supply of water for irrigation has to be stored in reservoirs against the dry season. Near the southern end of the Karnatak plain there occurs the sharply defined valley of Coimbatore, or Gap of Palaghat, towards which the high mountains on either side break very steeply down, and through which a railway now runs connecting Madras with Beypur. In the 200 miles between this gap and the southern point of the peninsula, there is the high mountain group of the Cardamoms, clothed with woods which yield an aromatic pungent spice. They terminate in a bold headland a little above Cape Comorin.

The inner triangular plateau thus inclosed lies from 1000 to 3000 feet above the level of the sea, and is approached by several famous passes from the level coast strip on the western side. The Bhore Ghat, for example, ascends a tremendous ravine about 40 miles south-east of Bombay city, to a height of 1798 feet. In ancient times it was regarded as the key to the Deccan, and could be held by a small band against any army attempting to penetrate from the coast. A celebrated military road was constructed by the British up this pass, and practically gave the command of the interior to the then rising port of Bombay. A railway line has now been carried up the gorge, twisting round the shoulders of mountains, tunnelling through intervening crags, and clinging along narrow ledges to the face of the precipice. At one point the zigzag is so sharp as to render a circuitous turn impossible, and the trains have to stop and reverse their direction on a levelled terrace. The Thall Ghat, to the north-east of Bombay, has in like manner been scaled both by road and railway. Another celebrated pass, further down the coast, connects the military centre of Belgaum with the little port of Vingurla. These landing-stairs from the sea to the interior present scenes of rugged grandeur. The trap rocks stand out, after ages of denudation, like circular fortresses flanked by round towers, from the mass of hills behind—natural fastnesses which in the Marhatta times were rendered impregnable by military art. In the south of Bombay the passes climb up from the sea through thick forests, the haunt of the tiger and the mighty bison.

The physical geography and the political destiny of the two sides of the Indian peninsula have been determined by the characteristics of the mountain ranges on either coast. On the east the country is comparatively open, and was everywhere accessible to the spread of civilization. On the east, therefore, the ancient dynasties of southern India fixed their capitals. Along the west only a narrow strip of lowland intervenes between two barrier ranges and the sea-board. The inhabitants of those tracts remained apart from the civilization of the eastern coast. To this day one of their ruling races, the Nairs, retain land-tenures and social customs, such as polyandry, which mark a much ruder stage of human advancement than Hinduism, and which in other parts of India only linger among isolated hill tribes. On the other hand the people of the western coast enjoy a bountiful rainfall, unknown in the inner plateaus and the east. The monsoon dashes its rain-laden clouds against the Western Ghats and pours from 100 to 200 inches of rain upon their maritime slopes from Khandesh down to Malabar. By the time the monsoon has crossed the Western Ghats, it has dropped the greater part of its aqueous burden, and central districts, such as Bangalore, obtain only about 35 inches. The eastern coast also receives a monsoon of its own; but, except in the neighbourhood of the sea, the rainfall throughout the Madras Presidency is scanty, seldom exceeding 40 inches in the year. The deltas of the three great rivers along the Madras coast form, however, tracts of inexhaustible fertility; and much is done by irrigation to husband and utilize both the local rainfall and the accumulated waters which the rivers bring down.

Of the three regions of India, the first, or the Himalayas, lies for the most part beyond the British frontier; but a knowledge of it supplies the key to the history and climatic conditions of India. The second region, or the river plains in the north, formed the theatre of the race-movements which shaped the civilization and political destinies of the whole Indian peninsula. The third region, or the triangular table-land in the south, has a character quite distinct from either of the other two divisions, and a population which is now working out a separate development of its own. Broadly speaking, the Himalayas are peopled by Turanian tribes; the great river plains of Bengal are still the home of the Aryan race; the triangular table-land has formed an arena for a long struggle between that gifted race from the north and what is known as the Dravidian stock in the south.

Rivers.—The vast level tract which thus covers Northern India is watered by three distinct river-systems. One of these river-systems takes its rise in the hollow trough beyond the Himalayas on the north, and issues through their western ranges upon the Punjab as the Sutlej and Indus. The second of the three river-systems also takes its rise beyond the double wall of the Himalayas, not very far from the sources of the Indus and the Sutlej. It turns, however, almost due east instead of west, enters India at the eastern extremity of the Himalayas, and becomes the Brahmaputra of Assam and Eastern Bengal. These rivers collect the drainage of the northern slopes of the Himalayas and convey it by long and tortuous, almost opposite, routes into India. Indeed, the special feature of the Himalayas is that they send down the rainfall from their northern as well as from their southern slopes to the Indian plains. The third river-system of Northern India receives the drainage of the southern Himalayan slopes, and eventually unites into the mighty stream of the Ganges. In this way the rainfall, alike from the northern and southern slopes of the Himalayas, pours down upon the river plains of India.

The Indus rises in an unexplored region (lat. 32° N., lon. 81° E.) on the slopes of the sacred Kailas Mountain, the elysium or Siva's paradise of ancient Sanskrit literature. It has an elevation of 16,000 feet at its source, a drainage basin of 372,700 square miles, and a total length of over 1800 miles. Shortly after it passes the Cashmere frontier, it drops to 14,000 feet, and at Leh is only about 11,000 feet above the level of the sea. The rapid stream dashes down ravines and wild mountain valleys, and is subject to tremendous floods. The Indus bursts through the western ranges of the Himalayas by a wonderful gorge near Iskardo (or Skardo), in North-western Cashmere, reported to be 14,000 feet in sheer depth. Its great feeder, the Sutlej, rises on the southern slopes of the Kailas Mountain. It issues from one of the sacred lakes of Manasarowar, famous in Hindu mythology, and still the resort of the Tibetan shepherds. Starting at an elevation of 15,200 feet, the Sutlej passes south-west across the plain of Guge, where it has cut through a vast accumulation of

deposits, by a gully 4000 feet deep, between precipices of alluvial soil. After traversing this plain, the river pierces the Himalayas by a gorge with mountains rising to 20,000 feet on either side. The Sutlej falls from 10,000 feet above sea-level at Shipki, a Chinese frontier outpost, to 3000 feet at Kampur, and to about 1000 feet at Bilaspur. After entering British territory it receives the waters of the Western Punjab, and the united stream falls into the Indus near Mithankot, after a course of 900 miles. About 800 miles of the course of the Indus are passed among the Himalayas before it enters British territory, and it flows for about 1000 more south-west, through the provinces of the Punjab and Sind. In its upper part it is fordable in many places during the cold weather; but it is liable to sudden freshets, in one of which Runjit Singh lost a force variously stated at from 1200 to 7000 horsemen while crossing the river. A little way above Attock the Indus receives the Cabul River, which brings down the waters of Afghanistan. The Indus supplies a precious store of water for irrigation works at various points along its course, and forms the great highway of the Southern Punjab and Sind. In its lower course it sends forth distributaries across a wide delta, the silt which it carries down helping to form numerous islands, mud banks, and shallows.

The Brahmaputra, like the Sutlej, rises near to the sacred lake of Manasarowar. Indeed the Indus, the Sutlej, and the Brahmaputra may be said to start from the same water-parting. The Brahmaputra, under its Tibetan name of Sanpu, flows eastward down the Sanpu valley, passing not far to the south of Lhasa, the capital of Tibet, and about 800 miles of its course are spent in the hollow trough on the north of the Himalayas. After receiving several tributaries from the confines of the Chinese Empire, the river twists round a lofty eastern range of the Himalayas, and enters British territory under the name of the Dihong, near Sadiya in Assam. It presently receives two confluents, the Dihong River from the north and the Brahmaputra proper from the north-east. The united triple stream then takes its well-known appellation of the Brahmaputra, literally the "son of Brahma or god." It then rolls down the Assam valley as a vast sheet of water broken by numerous islands, and so heavily freighted with silt from the Himalayas that the least impediment placed in its current causes a deposit, and may give rise to a wide-spreading almond-shaped mudbank. Steamers anchoring near the margin for the night sometimes find their sterns aground next morning on an accumulation of silt, caused by their own obstruction to the current. After a course of 450 miles down the Assam valley, the Brahmaputra sweeps round the spurs of the Garo Hills due south towards the sea, and for 180 miles rushes across the level plains of Eastern Bengal, till its junction with the Ganges at Goalanda. From this point the deltas of the two great river-systems of the Ganges and the Brahmaputra unite into one. But before reaching the sea their combined volume has yet to receive, by way of the Cachar valley, the drainage of the eastern watershed between Bengal and Burma, under the name of the Megna River, itself a broad and magnificent sheet of water. Unlike the Ganges and the Indus, the Brahmaputra is not used for artificial irrigation. But its silt-charged overflow annually replenishes the land. Indeed, the plains of Eastern Bengal watered by the Brahmaputra yield unfailing harvests of rice, with exhausting crops of jute, mustard, and oil-seeds, year after year, without any visible deterioration; and the valley of Assam is not less fertile, although inhabited by a less industrious race.

As the Indus, with its feeder the Sutlej, and the Brahmaputra convey to India the drainage from the northern slopes of the Himalayas, so the Ganges, with its tributary the Jumna, collects the rainfall from the southern slopes of the mountain wall, and pours it down upon the plains of Bengal. The Ganges traverses the central part of those plains, and occupies a more prominent place in the history of Indian civilization than either the Indus or the Brahmaputra. Its whole course lies to the south of the Himalayas, and for thousands of years it has formed a great physical influence in the development of the Indian races. The Ganges issues, under the name of the Bhagirathi, from an ice-cave at the foot of a Himalayan snow-bed 13,800 feet above the level of the sea, and after a course of 1557 miles it falls by a network of estuaries into the Bay of Bengal. It represents with its tributaries an enormous catchment basin—bounded on the north by a section of about 700 miles of the Himalayan ranges, and on the south by the Vindhyan Mountains—embracing 391,100 square miles. The maximum discharge of the Mississippi is 1,200,000 cubic feet of water per second; of the Nile at Cairo, only 362,000 cubic feet; and of the Thames at Staines, 6600 cubic feet; while at Rajmahal, about 1170 miles from its source, the Ganges has a high flood discharge of 1,800,000 cubic feet of water per second, and an ordinary discharge of 207,000 cubic feet; longest duration of flood, about forty days. One of the many mouths of the Ganges is 20 miles broad, with a depth in the dry season of 30 feet. But for a distance of about 200 miles the sea face of Bengal entirely consists of the estuaries of the Ganges, intersected by low islands and promontories formed out of its silt.

Of all the great rivers on the surface of the globe, none can compare in sanctity with the Ganges, or mother Ganga, as it is affectionately called by devout Hindus. And the river has indeed well earned the reverence of the people by centuries of unfailing work done for them. It and its tributaries are the unfailing water-carriers for the densely peopled provinces of Northern India, and the peasantry reverence the bountiful stream which fertilizes their fields and distributes their produce. None of the other rivers of India comes near to the Ganges in works of beneficence. The Brahmaputra and the Indus may have longer streams as measured by the geographer, but the upper sources of both lie beyond the great mountain wall in the unknown recesses of the Himalayas. Not one of the rivers of Southern India is navigable in the proper sense of the word. The Ganges begins to distribute fertility by irrigation as soon as it reaches the plains, within 200 miles of its source, and at the same time its channel becomes in some sort navigable. Thenceforward it rolls majestically down to the sea in a bountiful stream, which never becomes a merely destructive torrent in the rains, and never dwindles away in the hottest summer. Tapped by canals, it distributes millions of cubic feet of water every hour in irrigation; but its diminished volume is promptly recruited by great tributaries, and the wide area of its catchment basin renders its stream inexhaustible in the service of man. Embankments are in but few places required to restrain its inundations, for the alluvial silt which it spills over its banks affords in most parts a top-dressing of inexhaustible fertility. If one crop be drowned by the flood, the peasant comforts himself with the thought that his second crop will abundantly requite him.

It may give an idea of the value of the Ganges and its navigable tributaries when it is said that not fewer than 300,000 boatmen are occupied in its busy traffic. Large sea-going ships ascend it by the Hoogly mouth to Chandranagar, above Calcutta; steamers of light draught go up to Cawnpore, and thence a canal of 350 miles in length overcomes the difficulties of navigation upward to Hardwar, 1300 miles from the sea, where the river issues from the sub-Himalayan ranges. Its great tributary, the Jumna, is navigable up to the ancient city of Delhi, and, by canals which it supplies, for 200 miles beyond that point. The fluctuations and changes, both in its channels and in the size of these at different times of the year, are very great;

at Benares, for example, the depth of the Ganges varies between 35 and 78 feet, and its breadth in like proportion; the rising begins in the end of May, and is at its height in September. In July all lower Bengal near the rivers is inundated, so that the villages protected by embankments appear like islets in the wide expanse of waters dotted with craft of every sort.

These great northern rivers are supplied by both the melting snows of the Himalayas and by the rains carried to the mountain face by the south-west monsoon during the summer half of the year. Thus from the melting snows they begin to rise early in spring, and their depth is kept up by the succeeding rains. The rivers which rise on the highlands of the southern or peninsular portion of India are, however, dependent on the monsoon rains alone, and thus show greater but less enduring fluctuations of level during the year. The two rivers which drain westward to the Gulf of Cambay, between the Malwa plateau and the northern edge of the Deccan, are the Nerbudda and the Tapti; the former, rising in the highest land of Central India, has a westerly course of 750 miles, flowing with rapidity over basalt rocks which at intervals bar its passage, forming deep pools and waterfalls. It is thus of no considerable value for navigation, and when it is swollen by the monsoon rains its current descends with devastating velocity, carrying with it uprooted tree trunks and other debris. The Tapti, separated from the former by the Satpura range, has a similarly rocky bed and rapid fall, and is likewise subject to sudden and tremendous floods, after which it subsides into a mere chain of pools.

The eastern drainage of southern India to the Gulf of Bengal has more important streams. Nearest of these to the Ganges is the Mahanadi (Mahanuddy), drawing its tributaries from the heights of Central India, navigable by boats for nearly 400 miles during the greater part of the year, but notorious for its destructive floods. It passes the line of the Eastern Ghats by a fine gorge 40 miles in length, and thence flows quiet and deep to spread itself out in the wide delta by which it emerges into the gulf.

Next southward is the Godavari, the greatest river of the Deccan, rising at Nasik on the eastern slope of the Western Ghats, not very far from Bombay, and flowing east for 900 miles. Reaching the line of the Eastern Ghats, it is imprisoned for some 20 miles in a gorge, the scenery of which has been justly compared with that of the Rhine; here it flows in a narrow deep channel with a current that sometimes lashes itself into boiling whirlpools. Escaping from this, the water spreads over the plain, and is dotted with islands, many of which are ornamented by Hindu temples. Finally, it forms one great stream between flat and highly cultivated banks, from which a network of irrigating and navigable canals is drawn off, before breaking into the numerous channels of the large delta that it has pushed out into the sea.

Like the Godavari, the river Krishna or Kistna, rises in the inward slope of the Western Ghats, and descends the eastern edge of the plateau by a deep channel to reach the alluvial plains of the Coromandel coast. Its course of 800 miles affords scarcely any navigation, but some of its tributaries, passing through fine teak forests, are utilized for rafting down the timber. The Panar, Palar, and the Kaveri or Cauvery are the other considerable rivers of this slope. The last-named has its head stream in the highest part of the Western Ghats north of the Neilgherri Hills, and descends from the table-land to the eastern plain by two great falls, the upper 370, the lower 460 feet, in the midst of magnificent scenery. In the plain it is navigable for small craft during the rainy season, and is peculiarly adapted for irrigation. Its great delta, inclosed by two main branches, called the Coleroon (the larger) and the Kaveri or Cauvery, extends along the coast opposite the northern extremity of Ceylon for 80 miles.

Climate.—In such a vast region, stretching across 30 degrees of latitude, in Ceylon approaching to within 6 degrees of the equator, in Cashmere impinging upon the Pamir, and in Nepal rising to the highest summits on the globe, there is necessarily wide diversity. The general features of Indian climate are mainly determined by five conditions—latitude, the northern highlands, the elevation of the Deccan plateau, the neighbourhood of the western desert, and proximity to the Indian Ocean. The latitude produces tropical heats, tempered on the southern plateau by the general elevation of the land, intensified on the northern plains by the Himalayas, which refract the vertical summer solar rays, and in winter intercept the cold atmospheric currents from the bleak central Asiatic tablelands. The great desert intervening between the upper basin of the Ganges and the lower basin of the Indus helps to cause the hot blasts to blow over the north-west provinces. The Indian Ocean, surrounding the peninsula on two sides, supplies a superabundance of moisture during the prevalence of the southern monsoons. None of the Ghats or southern highlands are sufficiently elevated to arrest any large portion of the rain-bearing clouds, which at this time roll up continuously from the seething surface of the surrounding seas, sweeping over the Deccan plateau, penetrating far northwards through the head of the Bay of Bengal, and precipitating all their remaining humidity on the southern slopes of the Himalayas. From these conditions it results that while great heats prevail generally, the provinces south of the Satpura range are, on the whole, cooler than the Indus and Ganges basins, and that a considerable quantity of moisture is everywhere pretty evenly distributed.

The climate generally is distinguished by three well-marked seasons—the cool, the hot, and the rainy—which divide the year. The cool season extends from October till towards the close of February; the dry, hot season follows, and continues till the beginning of June, long before which time the great punkah fan must be set agoing in every house; the rainy season succeeds, and lasts with occasional intermissions till October. But during the cool period the heat is still great by day, though slight frosts occur in the elevated districts for an hour or two before sunrise, and a thin ice is formed. The greatest heat prevails on the lowlands of the Coromandel and Malabar coasts, and through the north-western sandy region. At Bombay the mean annual temperature is 84°, at Madras 83°, at Calcutta 77°, and at Delhi 72°, the extremes at Calcutta being 100° to 120°. The monsoon winds are the peculiar features of the climate, but are common to the neighbouring regions from Africa to the Malay peninsula. They blow periodically from the south-west and north-east, maintain the same direction for nearly half the year, and regularly succeed each other. The south-west monsoon commences about the middle of April and continues till September. It brings on the great rainy season to the Malabar coast and the Ganges plain, owing to the masses of vapour blown up from the ocean being arrested by the Western Ghats and the Himalaya Mountains. The showers descend in deluges, and commence with violent thunderstorms. The north-east monsoon follows with less decided features, and brings a rainy season to the Coromandel coast, usually lasting about two months. The change in the direction of the monsoon takes place at the equinoxes, and is attended with hurricanes and thunderstorms occasionally in May; but more frequently, towards the beginning of November, the rotatory hurricanes known as cyclones originate in the south-east part of the Bay of Bengal, and gyrating up north-west towards its narrow head, desolate the land for miles into the interior. They are followed by storm-waves which sweep along the coasts and islands, inundating the low-lying shores and destroying vast numbers of the inhabitants. In one such cyclone, on 31st October, 1876, more than 215,000 persons perished.

Two great periods, a wet and a dry, dividing the year in almost all parts of India, the storage of water for irrigation and against the dry season becomes of vital importance to the agriculture and to the subsistence of its inhabitants. Hence the multitude of irrigation canals and reservoirs (tanks formed by *bunds* or dams) which have been constructed over the whole land. The quantity of rain received by different parts of the country is various and fluctuating. Thus, on the Malabar coast, the wall of the Western Ghats, rearing itself up in opposition to the direction of the south-west monsoon, is deluged with a rainfall exceeding that of any other part of the earth's surface, and amounting frequently to 450 inches in the year; while the east coast receives hardly any from this direction, and at times its expected supplies fail altogether, the immediate result being a famine from the corresponding failure of the crops. The great Indian desert is almost rainless.

The maintenance of health on the part of Europeans depends more on their habits and mode of life than on the peculiarities of the climate itself. Travellers in India naturally choose the cool and delightful season, and are charmed; but if by unforeseen circumstances detained longer, the illusion is dispelled. Mr. Wilson, sent to India after the mutiny to adjust the disorganized finances, declared, after a brief cold-weather trip through the North-west Provinces, that India was the finest country he had ever seen. Returning, however, to Calcutta as the hot weather set in, he soon fell ill and died in the ensuing rainy season, stating shortly before his death that the Indian climate was the most detestable on the face of the globe. It is impossible for Europeans to live in the simple manner of Hindus, as some missionaries, with laudable desire to avoid what seemed to be undue indulgence, have found to their cost; but with temperance and fair precautions our countrymen stand the climate well, as a long roll of splendid service there amply testifies.

Vegetable Productions and Agriculture.—The extremely varied products of India are tropical and subtropical, according to latitude and elevation; and the native population exhibit great knowledge and skill in availing themselves of the varying conditions of moisture, soil, and temperature. Rice is the staple food in Lower Bengal, where the crop ripens in the three summer months; here also wheat is largely grown in winter, the reaping taking place in spring; but it is only on such rich lands that the temperate and tropical crops are raised in the same year on the same ground. It is only here and in a few other southern districts that rice is largely grown or forms the staple food of the people. The numbers who subsist on millet or wheat far exceed the rice-consuming population. Of the two former grains several varieties are cultivated. Maize is grown in small quantity over the whole country, but not as a corn crop; the grains are eaten after roasting. Pulses in great variety are cultivated, as are also yams, sweet potatoes, onions, garlic, &c. Indigo, cotton, and opium are very valuable crops; cotton is most largely grown in the Deccan, the rich soil from the decomposed trap rock being very suitable for it. Flax, hemp, jute, and other fibrous products, tallow, and coir from the cocoa-nut, may be raised in almost any amount. Indigo is a most important crop, Lower Bengal yielding the largest quantities. The provinces of Behar, Benares, and Malwa supply the government with vast quantities of opium from plantations of the poppy, at fixed rates. The sugar-cane is largely grown, but more as an article of food than for the manufacture of sugar. Pepper and cardamoms are important products of the Malabar coast and some other tracts. Tobacco, oil-seeds, ginger, saffron, turmeric, and other dyes, coriander, anise, cocoa, areca and other palms, teak-wood, considered equal, if not superior, to oak, and very abundant in the Western Ghats; benzoin, camphor, sarsaparilla, the banyan-tree, sandal-wood, bamboo, the splendid deodar pine, and a great variety of fine forest trees, are the other principal products of the vegetable kingdom. The Central and the Southern European fruits are of inferior quality in India; but the mango, the finest of Eastern fruits, tamarind, pine-apple, pomegranate, pisang or plantain, date, grape, citron, and almond are largely grown, and of fine quality. At experimental gardens, established in several places, natives are instructed in the art of horticulture. The tea plant, and persons skilled in its cultivation, were some years ago brought from China in order to form new plantations and improve the old in Kumaon and other parts of the lower ranges of the Himalayas. The experiment has been attended with complete success, and the result is an annually growing export of tea, not so much, however, from the upper districts of India as from Assam in the north-east, where hundreds of planters have settled, and whence there is easy water-way to Calcutta.

The cultivation of the soil forms the occupation of the Indian people in a sense which it is difficult to realize in England. As the land tax forms the mainstay of the imperial revenue, so the *ryot* or cultivator constitutes the unit of the social system. The village community contains many members besides the cultivators, but they all exist for his benefit, and all are maintained from the produce of the village fields. Even in considerable towns the traders and handicraftsmen almost always possess plots of land of their own, on which they raise sufficient grain to supply their families with food. The famine commissioners estimated that 90 per cent. of the rural population lived more or less by the tillage of the soil. India is, therefore, almost exclusively a country of peasant farmers. Even the so-called towns are merely groups of villages, in the midst of which the ploughman drives his cattle a-field and all the operations of agriculture go on. Indeed, the term municipality, which in Europe is only applied to towns, means quite as often in India a collection of rural homesteads for the purposes of local government.

The increase in the population has, however, developed a large landless class. The cultivated area no longer suffices to allow a plot of land for each peasant, and multitudes now find themselves ousted from the soil. They earn a poor livelihood as day labourers, and according to the census comprise one-eighth of the entire population. There is still enough land in India for the whole people, but the Indian peasant clings to his native district however overcrowded. Migration or emigration has hitherto worked on too small a scale to afford a solution of the difficulty. The cultivating classes have meanwhile had to fall back on inferior soils in order to support their growing numbers. They get a smaller average yield for their labours from such lands. Of this smaller return they have to pay a larger proportion to the landlords, by the operation of the economic law of rent. The result is that in some of the more thickly populated parts there is an agrarian war with landlords, and every conceivable device is resorted to in the courts in resisting any increase of rent. In many instances the landlords continue the tenants at their present rent rather than face the endless and often ruinous litigation an increase would involve.

Agriculture is carried on in the different provinces with an infinite variety of detail. Everywhere the same perpetual assiduity is found, but the inherited experience of generations has taught the cultivators to adapt their simple methods to differing circumstances. The deltaic swamps of Bengal and Burma, the dry uplands of the Karnatak, the black-soil plains of the Deccan, the strong clays of the Punjab, the desert sand of Sind or Rajputana, require their separate modes of agriculture. In each case the Indian peasant has learned, without scientific instruction, to grow the crops best suited to the soil. His light plough, which he may be seen carrying a-field on his shoulders,

makes but superficial scratches; but what the furrows lack in depth they gain by repetition, and in the end pulverize every particle of mould. Where irrigation is necessary native ingenuity has devised the means. The inundation channels in Sind, the wells in the Punjab and the Deccan, the tanks in the Karnatak, the terraces cut on every hillside, water at the present day a far larger area than is commanded by government canals.

Cotton still holds the first place among agricultural products grown for export. The present importance of the crop dates from the stoppage of American supplies during the civil war. From an annual export of £3,000,000 sterling it increased by leaps to £37,000,000 in 1866. The short Indian staple, known in Liverpool as Surat, could not, however, contend with the American supply when the latter was resumed, and export soon fell to less than £8,000,000.

Jute ranks next to cotton as a fibre crop. The extension of its cultivation has been equally rapid, but it is more limited in its area, being practically confined to Northern and Eastern Bengal. The cultivation is very profitable, and the demand for jute in Europe has contributed more than any administrative measure to raise the standard of comfort throughout Eastern Bengal.

Indigo is one of the oldest, and, until the introduction of tea-planting, it ranked as the most important of the Indian staples grown by European capital. In Bengal proper its cultivation has greatly declined since the early years of this century, and of late years its place has been, to a considerable extent, taken by the new aniline and other chemical dyes.

The opium of commerce is grown and manufactured in two special tracts: (1) the valley of the Ganges round Patna and Benares; and (2) a fertile table-land in Central India, corresponding to the old kingdom of Malwa, for the most part still under the rule of native chiefs, among whom Sindhia and Holkar rank first. In Malwa the cultivation of the poppy is free, and the duty is levied as the opium passes through the Presidency of Bombay; in Bengal the cultivation is a government monopoly. Opium is also grown for local consumption throughout Rajputana, and to a very limited extent in the Punjab and the Central Provinces. Throughout the rest of India it is absolutely prohibited. As will be seen under *Finance*, it forms one of the most lucrative sources of Indian revenue.

The cultivation of coffee is confined to Southern India, although attempts have been made to introduce the plant both into British Burma and into the Bengal district of Chittagong. The coffee tract may be roughly defined as a section of the landward slope of the Western Ghats, extending from Kanara in the north to Travancore in the extreme south. This tract includes almost the whole of Coorg, the districts of Kadur and Hassan in Mysore, and the Neilgherri Hills. Unlike tea, coffee was not introduced into India by European enterprise, and even to the present day its cultivation is largely conducted by native proprietors.

The growing of tea has of late years been carried on with such success that India bids fair to be a formidable competitor with China in the production of this favourite beverage. The tea plant (*Thea viridis*) grows wild in Assam, which has therefore been considered to be its real home, and that it was from this province introduced, at some prehistoric date, into China, as neither in the latter country nor in Japan is the wild shrub known. The discovery in Assam was made soon after the conquest of the province from the Burmese in 1826, and in 1834 a movement was begun with a view to introducing tea-culture into India. Much failure and discouragement attended the first beginnings, and it was not until 1860 that the export reached 1,000,000 lbs. By 1870 this had risen to 14,000,000, and in 1884 it reached 65,000,000 lbs., valued at nearly £4,000,000. By far the larger portion is the produce of Assam, Bengal comes next, and then, in smaller quantities, the North-west Provinces, the Punjab, and Madras.

Cinchona cultivation dates from 1860, when Peruvian bark trees were introduced in order to secure a supply of quinine independent of South America. The experiment in arboriculture was not only successfully conducted, but proved remunerative in a pecuniary sense. A cheap febrifuge has been provided for the fever-stricken population of the Indian plains, while the surplus bark sold in Europe more than repays interest upon the capital expended.

To anyone who may regard India as a country of superabundant population and periodic famines, it may sound strangely to cite our great possession as among the future sources of our own food supply. As a matter of fact, however, India has for some years been sending us supplies, in varying quantity, of very excellent wheat. The export in 1888 rose to nearly 20,000,000 cwts., chiefly from the rich *doabs* of the Punjab—a region renowned for its fertility whenever the inhabitants have been left in peace, and which includes the very ground traversed by Alexander the Great, and subsequently by Tamerlane, Mahmoud of Ghazni, and other Asiatic conquerors. There are 21,000 miles of splendid roads in the Punjab, good railway facilities, and the province is more than 1000 miles nearer England than Australia. The necessary agricultural labour, moreover, so difficult to obtain at the antipodes, is there abundant, and needs but proper organization to very greatly multiply the output of food-stuffs which would be very welcome in the markets of the United Kingdom.

Minerals.—India was described some 300 years B.C. as having "numerous underground veins of all sorts of metals, for it contains much gold and silver, and copper and iron in no small quantity, and even tin and other metals which are employed in making articles of use and ornament as well as the implements and accoutrements of war." And for centuries after the Christian era began India was invested with a halo of romance; it was a fanciful, almost a fabulous India, and this chiefly in relation to its possession of gold and gems. The reputation, however, was founded not so much upon the treasures of its own mines as upon the accumulations of its princes, who have ever been renowned, beyond all Oriental rulers, for a love of gorgeous display. The precious metal has probably never been found here to such an extent as in California or Australia, but the supply was doubtless more plentiful than now. It is still found in a state of minute diffusion in many alluvial soils, and in the sands of many rivers; and some richly auriferous reefs of quartz rock are worked. Precious stones of great value and beauty are occasionally found, but not to any prolific extent. A few diamonds are found at Punnah, in Bundelkhand, but scarcely in paying quantity. Golconda, the far-famed home of the Koh-i-noor, the Regent, and other wondrous gems, was only a diamond-cutting town, the precious stones being found in a neighbouring district of Hyderabad, long since exhausted. All over the country the hills teem with iron, and in purity of ore and antiquity of working the deposits of India probably rank first in the world. Iron was formerly manufactured here on an immense scale, and the skill displayed in its workmanship has been, and will always be, a subject of marvel. A very few years ago no foundry in Europe could have produced such a mass of wrought iron as the famous iron pillar at the Kutab, near Delhi, and, according to the analysis of Dr. Percy, it consists of pure malleable iron without alloy. Mr. Fergusson, from the inscription on it, places its date about A.D. 400, and, though exposed to the atmosphere for thus nearly fifteen centuries, it shows no sign of rust, and still stands a monument to the skill and art of the Indian ironworker. There was a time, and that not very remote, when the Indian steel was in considerable demand even by cutlers in England. The famous

Damascus blades had for ages attained a reputation for flexibility, strength, and beauty before it was known that the material from which they were made was produced in an obscure Indian village, and that traders from Persia found that it paid them to travel for the raw material from Ispahan to Nirmal in Hyderabad. It is not long since Indian pig-iron brought large prices in England for steel manufacture, and a large quantity of this pig was used in the construction of the Britannia tubular and Menai bridges. The native method of manufacture, however, required an extravagant use of charcoal, so much so that government was compelled to interfere with the wholesale destruction of forests which its supply involved. Reduced to the use of a coal not always either accessible or suitable for the purpose, it became cheaper to use imported iron, and the native iron production has nearly died out. So far as the actual resources of the country are concerned, were India to be wholly isolated, as she once practically was, from the rest of the world, there can be no doubt that she would be able, from within her own boundaries, to supply very nearly all the requirements, so far as the mineral world is concerned, of a highly-civilized community; but there is also no doubt that the consumer would have to pay for his requirements more than he does at the present day.

Coal is obtained in numerous localities, chiefly at Raniganj, about 125 miles inland from Calcutta, and the Chanda district, near Nagpur. Its production has gone hand in hand with railway extension, and if the quality were good enough would doubtless be turned out to avoid importing. It has, however, the great drawback of a low proportion of fixed carbon and an excessive proportion of ash, which amounts to about 20 per cent., as against 3 to 6 per cent. in English coal. The demand is constant and increases with every fresh mile of railway and every new factory; but as the best Indian coals can only do from one-half to two-thirds the work performed by the same amount of English coal, the latter will always be in demand. The native output is about 1,000,000 tons per annum.

Salt is the mineral production which, of all others, is the most important to the Indian revenue, the annual gross amount received as tax on this commodity amounting to about £7,000,000 sterling. The import trade in salt is still very considerable, though the native sources are many, and their supply practically inexhaustible. Bengal and Assam, for instance, get nearly the whole of the salt which they require for a population of 70,000,000 by sea from England—a strange freak of commerce, considering the unlimited supply of salt to be had in Central and Northern India, whence there is direct railway communication to Bengal. The whole of Southern India, including the Madras and Bombay Presidencies, get their salt from the sea on their coasts. Northern India is supplied either by the Punjab, which possesses salt mines of immense extent, or from Rajputana, in which are many lakes and springs producing excellent salt, and of which the Sambhar Lake is the best known. It is a shallow lake about 20 miles long by an average of 5 in breadth, the greatest depth at the end of the rainy season not being over 3 feet. Its drainage area is 2200 square miles. The specific gravity of the lake water is from 1·03 during rains to 1·15 and 1·20 during the dry season, when salt begins to be deposited. As to the source of this supply, it seems not improbable that underneath the widespread sandhills which surround the lake there are beds of salt, the result of some former marine deposit. The output from this lake is upwards of 120,000 tons annually.

Canals and Irrigation.—The periodical character of the water supply renders artificial means of storing and conveying it absolutely necessary in many parts of India. The rains must be caught and stored against the lengthened season of dry weather, possibly of drought; while the swollen volume of the rivers must be drawn off at the time of flood, for what is a torrent then will be almost a dry channel later on. Some very fine canals were constructed by the old Hindu and Mogul rulers, but their irrigation system never assumed such magnificent proportions as at the present day. The chief scenes of these operations are the country between the Jumna and the Ganges, several parts of the Punjab, and the deltas of the Mahanadi, the Godavari, the Kistna, and the Kaveri on the east coast, and the delta of the Indus on the north-west coast. In no part of India has irrigation been conducted with greater perseverance and success than in the Indus Valley. The entire province of Sind, and hardly less the lower districts of the Punjab are absolutely dependent upon the floods of the Indus. The average rainfall in Sind is barely 10 inches in the year, the soil is a thirsty sand, and, above all, the river does not run in confined banks, but wanders at its will over a wide valley. Speaking generally, no crop can be grown in Sind except under irrigation, and therefore the total cultivated area of 3,000,000 acres may be regarded as entirely dependent upon artificial water supply. The supply is derived from the river by two main classes of canals—(1) inundation channels, which only fill when the Indus is in flood; and (2) perennial channels, which carry off water by means of dams at all seasons of the year.

Many of the main canals of India have been constructed with the double purpose of a cheap water carriage as well as for irrigation, and answer the two ends in a very admirable manner. Canals in England afford no idea of such constructions in India. Canals there mean perfect navigable channels of from 20 to 60 yards broad, with locks 20 feet by 120 feet or 150 feet long, made to fill and empty in one minute, fitted for steamers of 200 or 300 tons, and of any speed. The works afford cheap means of travel and of goods transit, which is of inestimable value to a population so poor as that of India. It is this indeed which gives the great value to irrigation itself, by opening very distant markets at an almost nominal cost of carriage; thus greatly increasing the value of every article produced, as the irrigation increases the quantity.

Zoology.—The forests, with the jungle of the plains, are still tenanted by vast numbers of wild animals, birds, and especially reptiles. So destructive are many of these that about 20,000 human beings and 50,000 head of cattle are yearly destroyed by wild beasts and venomous snakes. Man suffers mostly from the cobra and other reptiles, while the herds are ravaged chiefly by the tiger, panther, and other large beasts of prey. India is probably the indigenous home of the tiger, which is found in every part of the country, and which, in the Royal Bengal species, attains his highest development. He preys chiefly on deer, flocks, and herds, but will sometimes turn upon man, and once he has tasted human flesh prefers it to any other. The "man-eater," as he is then called, is one of the greatest scourges of the villages lying on the skirt of the jungle. Rewards are offered by the authorities to secure the destruction of these animals.

Scarcely less formidable is the gray panther, or rather leopard, which also occasionally becomes a man-eater. But the cheetah, a somewhat smaller tawny-coloured species, is kept by native princes and trained for hunting. He is conveyed blindfold in a cart to within a short distance of a herd of deer when the hood is suddenly removed. In a few wonderful bounds he has seized the quarry, or, missing it, abandons the pursuit, having spent all his energy on a single effort.

Other large wild animals are the bear and wild boar, very generally the rhinoceros, chiefly in the woods at the foot of the Eastern Himalayas, the bison, gayal (*Bibos frontalis*) in the Ghats and North Assam hills; the lion, in some parts maneless, is rarely found beyond Rajputana and Guzerat; the elephant, still met in large herds in

Nepal, the hilly districts of Eastern Bengal, the Neilgherries, and some other parts; two species of the alligator, the harmless "sharp-nosed" and the dangerous "snub-nosed," frequenting not only most of the large rivers, but many of the numerous tanks scattered over the country. Deer and antelopes abound in immense variety, while the ibex, ovis ammon, and fine fleece-bearing goat and sheep are numerous, especially in the Western Himalayas. Many poisonous serpents are found; of these the most dangerous are the cobra di capello, or black-hooded snake, found chiefly in Malabar; the cobra manilla, the sand-snake, and snake of the Ghats. Of the non-poisonous snakes the python, of the Boa family, is the most formidable, growing to the length of 30 feet; it kills by constriction, rapidly twisting itself round the body of its victim. It extends through Burma into the islands of Malayasia. Of the Chelonia the most remarkable is the huge tortoise. The birds are extremely numerous and of splendid plumage. India is the native country of the peacock, as Colchis of the pheasant. Another peculiar and singular bird is the grossbeak, which forms a nest pendent from a branch or twig so slender that no snake could reach its extremity. Other notable species are the pelican, flamingo, tailor-bird, bulbul, adjutant, many vultures, eagles, the ibis, parrots, pigeons, the jungle-fowl, &c. Insect life is fully developed in myriads of mosquitoes, locusts, huge beetles and spiders, termites and other ants, centipedes, bees, wasps, and butterflies, the firefly, and countless other species.

As a rule the domestic animals, like many of the cultivated plants, are inferior to those of most other countries. The sheep, oxen, camels, and especially the horses, are generally of indifferent stock, although some hardy breeds of ponies occur in the Himalayas, and the camel of Bikanir in Rajputana is noted for its great size, strength, and swiftness. Large herds of oxen, camels, sheep, and goats occur chiefly in the Punjab and Rajputana, but India is on the whole more an agricultural than a grazing land. Hence, although there are a vast number of wild tribes in the more inaccessible hilly districts, there are, strictly speaking, no pastoral nomads, except, perhaps, the Ladakhi Champas and a few others of Mongolian stock, who according to the seasons migrate between the southern and Tibetan slopes of the inner Himalayas in search of a scanty pasturage for their flocks.

Area and Population.—Religious prejudices and the peculiar mode of life of the natives of India interposed serious obstacles through many years to the taking of an accurate census of India. The first time these were successfully overcome and a complete census obtained was during the years 1872 to 1876, when the actual population was found to be 239,395,498, or at least 40,000,000 more than the estimate previously formed, in the singular proportion of 100 males to 94 females, there then being 3,500,000 more males than females, or nearly 6 per cent. The census of 1881 considerably increased this proportion, the actual number of males in excess of females being 6,033,143. The total area and population, according to the returns of 1881, are as follows:—

AREA AND POPULATION IN 1881.

Presidencies and Provinces under the Administration of	Area in Square Miles.	Population.		
		Males.	Females.	
The Governor-General of India—				
Ajmere and Mhairwara,	2,711	248,844	211,878	460,722
Berar,	17,711	1,380,492	1,292,181	2,672,673
Coorg,	1,583	100,439	77,863	178,302
Andaman Islands (Port Blair),	880	12,640	1,988	14,628
Governors—				
Madras,	139,900	15,278,233	15,590,271	30,868,504
Bombay (including Sind and Aden),	124,134	8,520,453	7,968,821	16,489,274
Lieutenant-Governors—				
Bengal,	150,588	33,174,651	33,516,805	66,691,456
North-west Provinces and Oudh,	106,111	22,912,556	21,195,313	44,107,869
Punjab,	106,632	10,210,053	8,640,384	18,850,437
Chief Commissioners—				
Assam,	46,341	2,503,703	2,377,723	4,881,426
British Burma,	87,220	1,991,005	1,745,766	3,736,771
Central Provinces,	84,445	4,959,435	4,879,356	9,838,791
Total, British Territory,	868,256	101,292,504	97,498,349	198,790,853
Native States—				
Baroda,	8,570	1,139,512	1,045,493	2,185,005
Central India Agency,	75,079	4,882,823	4,379,084	9,261,907
Hyderabad,	81,807	5,002,137	4,843,457	9,845,594
Mysore,	24,723	2,085,842	2,100,346	4,186,188
Rajputana Agency,	129,750	5,544,665	4,723,727	10,268,392
Bengal,	36,634	1,450,940	1,394,465	2,845,405
North-west Provinces,	5,125	384,699	357,051	741,750
Punjab,	35,817	2,112,308	1,749,380	3,861,688
Central Provinces,	28,834	867,687	842,033	1,709,720
Madras,	9,192	1,641,759	1,661,804	3,303,563
Bombay,	73,753	3,572,355	3,368,894	6,941,249
Total Native States,	509,284	28,684,722	26,465,734	55,150,456
Grand Total, India,	1,377,540	129,977,226	123,964,083	253,941,309

This gigantic population, occupying 714,759 towns and villages, in which are comprised 43,540,438 houses, is considerably more than double the number of all the races and nations which bowed to the sway of imperial Rome. Perhaps a better idea may be formed of the vastness of our Indian Empire by comparing it in population with some of the greatest western kingdoms. The province of Bombay is equal, both in population and wealth, to a first-class European state. The province of Madras has an area and population far larger than Italy. The whole German Empire and England and Wales together would not equal Bengal in population. The North-west Provinces contain about 2,000,000 more men than France. Oudh has a population equal to that of Belgium, Holland, and Denmark united; while the Punjab, the poorest Indian province, is more populous than Spain, has a larger revenue, and, it need scarcely be added, an infinitely more regular administration. As regards cities, Calcutta, with its 800,000 inhabitants, is second only to London in the whole British Empire. Bombay, the third largest city, has 130,000 more than Liverpool; and Madras is considerably more populous than either Dublin, Manchester, or Birmingham. Lucknow has 70,000 more people than Edinburgh; while there are fourteen cities with considerably over 100,000 inhabitants, and twenty-eight others having each a population of more than 50,000. Each of the provinces and every native-governed state of importance is described in a separate article.

Revenue, Expenditure, and Debt.—According to the Act of 1858, the revenue and expenditure of the Indian Empire are subjected to the control of the secretary in council, and no grant or appropriation of any part of such revenue can be made without the concurrence of the majority of the council. The accounts of the whole revenue and expenditure of the Indian Empire must be laid annually before the English Parliament.

The most important sources of public revenue to which the rulers in India have in all ages looked for obtaining their income are—

(1) The land, the tax on which, in the year before the mutiny, furnished more than one-half the total receipts of the East India Company's treasury. The proportion is not now quite so much, other sources of revenue having since been added.

The land revenue of India, as of all Eastern countries, is generally regarded less as a tax on the landowners than as the result of a joint proprietorship in the soil, under which the produce is divided in unequal proportions between the ostensible proprietors and the state. In some sense, indeed, it may scarcely be regarded as a tax at all, seeing the government may be considered as possessing the rights of landlord, and as such receiving the rental which in England goes to private proprietors.

Under these circumstances it is a matter of justice and convenience that the rental or land-tax should be fixed upon some general and clearly understood principles. In Bengal a permanent settlement was made in 1793 by Lord Cornwallis with the zemindars, or principal landowners, who pay the government a sum probably somewhat exceeding one-half the amount which they collect in the form of rent. Under this arrangement the government does not directly deal with the holder or cultivator of the soil, but with middlemen whose position most nearly approaches that of landlord.

In Madras and other parts the ryotwar system prevails, under which every registered holder of land is recognized as its proprietor, and pays direct to the government. He can sublet, transfer, sell, or mortgage it; he cannot be ejected by the government, and so long as he pays the fixed assessment he has the option of increasing or diminishing the cultivation on his holding, or he may entirely abandon it. In unfavourable seasons remissions of assessment are granted. The assessment is in money, and does not vary from year to year, except when water is obtained from a government source of irrigation; nor is any addition made to the rent for improvements effected at the ryot's own expense. An annual settlement is made, not to re-assess the land, but to determine on how much of his holding the ryot shall pay; when no change occurs in the holding the ryot is not affected by the annual settlement, and is not required to attend it. To carry out this system the country is surveyed and mapped, and the fields distinguished by permanent boundary marks, which it is penal to remove. The soil of each field is classed according to its intrinsic qualities and to the climate; and the rate of assessment to be paid on fields of each class, in each subdivision of a district, is fixed on a careful consideration of the value of the crops they are capable of producing, as affected by the proximity to market-towns, roads, canals, railways, and similar external incidents, but not by improvements by the ryot himself. The measurement and classification of the soil are made once for all, but the rate of assessment is open to revision at the end of every thirty years, in order that the ryot, on the one hand, may have the certainty of the long period as an inducement to lay out capital; and the state, on the other, may secure that participation in the advantages accruing from the general progress of society to which its joint proprietorship in the land entitles it. In the thirty years' revision, moreover, only public improvements and a general change of prices—but not improvements effected by the ryots themselves—are considered as grounds for increasing the assessments. The ryot's tenure is permanent, if he pays the assessment.

In Bombay and the North-west Provinces the system is also ryotwary, while in Oudh the settlement made after the mutiny of 1857 conferred rights in perpetuity on the talookdars, or large landlords. In the Punjab the village communities, which have maintained their integrity more fully than elsewhere, pay the revenue, which is here assessed for periods of thirty years.

It will be seen, therefore, that the Indian government may be regarded as the landlord of a vast estate—probably the largest in the world. What is the rent-roll of this great landed proprietor? In 1793 it amounted to £3,913,000; in 1815, after some accessions of territory, to £11,750,000; in 1843, to £14,000,000; while by other accessions of territory and general improvements it had by 1884 risen to £22,000,000—reduced by charges for collection to a net sum of £19,000,000. Large as this sum may appear, it only amounts to an average of less than 1*s.* per acre over the whole area of the large estate. On revenue-paying cultivated or otherwise utilized area, however, the incidence averages 2*s.* 8*d.* per acre.

(2) The state in India is not only the greatest landlord, but it carries on an extensive business as farmer and merchant; and next in importance to the land-tax, as a great source of Indian revenue, is the income derived from the opium monopoly. About 580,000 acres in Bengal and 550 in Bombay are devoted to the cultivation of the poppy, the juice of which is sold to the government at a certain fixed price, manufactured into opium at the official factories, and sold by auction, chiefly at Calcutta, to merchants who export it to China. The growth and manufacture are strictly supervised, and are prohibited except under such supervision. This of course cannot be extended to opium grown in native states, but upon it an export duty is levied which prevents it from competing to the disadvantage of the government. The poppy is not cultivated in the Madras Presidency. The revenue derived from opium is variable, averaging about £9,300,000 annually in the ten years ending 1884.

(3) Next to opium, the largest revenue in India is derived from salt—the amount now being annually about £6,500,000.

(4) The excise duty on spirits and drugs, or, as it is sometimes called, the *abkari* revenue, yields about £3,500,000 per annum.

(5) The produce of the customs revenue, derived from export as well as import duties, may be put at about £2,000,000 annually.

(6) Stamps yield about £3,300,000, and do not differ materially in general character from those in use in Great Britain.

(7) Provincial rates—that is, levies peculiar to individual provinces—the net annual receipt from which (deducting charges for collection, as in the other cases) is about £2,600,000.

From the above sources the revenue of India amounts to as nearly as possible £50,000,000 per annum. The actual Indian balance sheet shows a considerably larger revenue, as the accounts include amounts received and expended on account of public works, railways, post office, and telegraphs. The two latter are in India items of loss instead of profit as in England.

The ordinary expenditure of India amounts to nearly £50,000,000 per annum, the largest items being for the army, interest on debt, and expenses of collection of revenue. In addition a sum of between £5,000,000 and £7,000,000 per annum is expended on public works which are not classed as productive. The following table gives the exact figures of revenue and expenditure for 1885 according to the official returns:—

PRINCIPAL SOURCES OF REVENUE.

Land revenue,	£21,832,211
Opium monopoly,	8,816,469
Salt duty,	6,507,236
Excise on spirits, &c.,	4,011,867
Customs,	1,029,943
Stamps,	3,606,622
Provincial rates,	2,791,461
Miscellaneous, under £1,000,000 (tributes, forest proceeds, &c),	2,484,613
	£51,080,422

OTHER SOURCES OF REVENUE.

Post office, telegraph, and mint,	£1,797,846
Productive public works (chiefly railways),	13,574,106
Public works not classed as productive,	615,097
Receipts by civil departments,	1,373,144
Receipts by military department,	815,170
Miscellaneous,	1,434,896
	£19,610,259
Total,	£70,690,681

PRINCIPAL HEADS OF EXPENDITURE.

General administration,	£1,666,925
Law and justice,	3,305,978
Police,	2,832,725
Marine (including river navigation),	531,973
Education,	1,238,787
Ecclesiastical,	166,411
Medical,	743,722
Political and scientific departments,	1,256,646
Superannuation allowances and pensions,	2,546,006
Civil furlough and absentee allowances,	261,306
Territorial and political pensions,	671,349
Interest on debt,	4,619,443
Army services,	16,963,803
Collection of revenue, drawbacks, &c.,	9,559,055
Stationery, printing, and miscellaneous,	811,825
	£47,175,954

OTHER HEADS OF EXPENDITURE.

Post office, telegraph, and mint,	£2,145,249
Productive public works (chiefly railways),	12,949,306
Public works not classed as productive,	7,258,261
Famine relief works and insurance,	1,548,357
	23,901,173
Total,	£71,077,127

The revenues of the Mogul Empire, derived from a much smaller area and population than those of British India, varied from £42,000,000 net under Akbar in 1593, to £80,000,000 under Aurungzebe in 1695. If we examine the items in the Mogul accounts we find the explanation of their enormous totals. The land tax then, as now, formed about one-half of the whole revenue. The net land revenue demand of the Mogul Empire averaged £25,000,000 sterling from 1593 to 1761; the annual *net* land revenue raised from the much larger area of British India during the ten years ending 1884 has been £18,000,000 sterling (gross £21,000,000). But besides the land revenue there were under our predecessors not less than forty imposts of a personal character. These included taxes upon religious assemblies, upon trees, upon marriage, upon the peasant's hearth, and upon his cattle. How severe some of them were may be judged from the poll tax. For the purposes of this tax the non-Mohammedan population was divided into three classes, paying respectively £4, £2, and £1 annually to the exchequer for each adult male. The lowest of these rates, if now levied from each non-Mohammedan male adult, would alone yield an amount exceeding our whole taxation. Yet under the Moguls the poll tax was only one of forty burdens!

The public debt of India, including that incurred in Great Britain, was £60,000,000 in 1857. In the course of the next five years it was largely increased, and stood at £100,000,000 in 1862. From 1862 to 1868 the government were enabled to pay off a portion of it, and in the latter year the amount was £95,000,000. Since then, however, there has been a steady increase. In 1873 the amount was £105,000,000; in 1878 it had risen to £135,000,000, and in 1887 it stood at £160,000,000. It is only fair to explain that the whole of the increase since 1868 is due to expenditure on public works, which amounted to more than £70,000,000 in that period. The rates of interest on the debt has been reduced from 5½ to 5 and 4 per cent., and India can now borrow on terms second only to those commanded by England. About £20,000,000 of the debt is held by natives.

Commerce and Trade.—From the earliest days India was a trading country, and her name has passed into poetry as synonymous with costly merchandise. Philology proves that the precious cargoes of Solomon's merchant ships came from the coast of Malabar, and the brilliant mediæval republics of Italy drew no small share of their wealth from their Indian trade. It was the hope of participating in this trade that stimulated Columbus to the discovery of America, and Da Gama to the circumnavigation of the Cape. Spices, drugs, dyes, and rare woods, fabrics of silk

and cotton, jewels and gold and silver—these were the temptations which allured the first adventurers from Europe. The East and the West were then separated by a twelvemonth's voyage, full of hardships and perils. A successful venture made the fortune of all concerned; but trade was a lottery, and not far removed from piracy. Gradually, as the native kingdoms fell, by internal anarchy rather than by violence from without, and the proud cities of mediæval India sank into ruin, the legendary wealth of India was found to rest upon an unstable basis. It has been reserved for our own day to discover, by the touchstone of free trade, the real source of her natural riches, and to substitute bales of raw produce for boxes of curiosities. The cotton, grain, oil-seeds, and jute of India now support a large industrial population both in the country of their growth and in England.

A large external trade was an impossibility under the Mogul emperors. Their capitals of Northern India, Agra and Delhi, lay more than 1000 miles from the river's mouth; and even the capitals of the sea-board provinces were chosen for military purposes, and with small regard to their commercial capabilities. One of the earliest results of British rule in India was the growth of great mercantile towns. Our rule derived its origin from our commerce, and from the first the East India Company's efforts were directed to creating centres for maritime trade.

It is in this difficult enterprise, in which the Portuguese, the Dutch, the Danes, and the French had successively failed, that the British in India have succeeded. We make our appearance in the long list of races who have ruled that splendid empire, not as temple builders, like the Hindus, nor as palace and tomb builders, like the Mohammedans, nor as fort builders, like the Marhattas, nor as church builders, like the Portuguese; but in the more commonplace capacity of town builders, as a nation that had the talent for selecting sites on which great commercial cities would grow up, and who have in this way created a new industrial life for the Indian people.

Calcutta and Bombay, the two commercial capitals of India, are the slow products of British rule. Formerly, the industries of India were essentially domestic manufactures, each man working at his hereditary occupation, at his own loom or at his own forge. To a very great extent this is still the case, particularly in the rural districts; but under British rule a new era of production has arisen in India—an era of production on a great scale, based upon the co-operation of capital and labour, in place of the small household manufactures of ancient times. The husbandmen simply raised the food grains necessary to feed them from one harvest to another. If the food crops failed in any district, the local population had no capital and no other crops wherewith to buy food from other districts; so, in the natural and inevitable course of things, they perished. Now the peasants of India raise other and far more profitable crops than the mere foodstuffs on which they live. They also raise an annual surplus of grain for exportation, which is available for India's own wants in time of need; and there is a much larger aggregate of capital in the country, that is to say, a much greater national reserve or staying power.

At the beginning of the last century, before the English became the ruling power in India, the country did not produce £1,000,000 a year of staples for exportation. During the first three-quarters of a century of our rule, the exports slowly rose to about £10,000,000 in 1834. During the half century since that date the old inland duties and other remaining restrictions on Indian trade have been abolished. Exports have multiplied by sixfold. In 1883 India sold to foreign nations £84,000,000 worth of strictly Indian produce, which the Indian husbandman had raised. In that year the total trade of India, including exports and imports, exceeded £148,000,000.

With an extensive sea-board of some 3000 miles, India has comparatively few ports. Calcutta monopolizes the commerce, not only of Lower Bengal, but of the entire river-systems of the Ganges and the Brahmaputra. Bombay is the sole outlet for the products of Western India, Guzerat, the Deccan, and the Central Provinces; Karachi (Kurachee) performs a similar office for the valley of the Indus, and Rangoon for that of the Irawaddi. These four ports have been chosen as the termini where the main lines of railway debouch on the sea. In the south of India alone is the sea-borne trade distributed along the coast. The western side has a succession of fair-weather ports, from Goa to Cochin. On the east there is not a single safe harbour, nor a navigable river mouth, but ships anchor some miles off the shore at Madras, and at several other points, generally near the mouths of the rivers. Of the total foreign trade of India, Calcutta and Bombay control about 40 per cent. each, Madras has 6 per cent., Rangoon 4 per cent., and Karachi 2 per cent., leaving a balance of only 8 per cent. for all the remaining ports of the country. Calcutta and Bombay form the two central depots for collection and distribution to a degree without a parallel in other countries.

By far the larger share of the total import and export trade, amounting to 61 per cent., is connected with the United Kingdom; next comes China, with 13 per cent., and then the following countries in order:—France, Straits Settlements, Ceylon, Italy, United States, Mauritius, Austria, Persia, Arabia, Turkey, Egypt, Australia, Aden, East Coast of Africa.

The number of vessels engaged in the foreign trade which entered and cleared at the several ports of India in 1883 was 11,715, of a total burden of 7,071,884 tons. Of the vessels 4257 (5,366,770 tons) were British, 2525 (361,189 tons) were British Indian, and 3099 (175,632 tons) were native craft, leaving but a comparatively small proportion for the eighteen or twenty other nationalities.

The foreign trade of India is, as already mentioned, monopolized by four great ports, but the entire sea-board along both sides of the peninsula is thronged by native craft, which do a large coasting business. In the Gulfs of Cutch and Cambay, on the Malabar coast, and in the southern districts facing Ceylon, a large portion of the inhabitants are born sailors, conspicuous alike for their daring and skill in navigation. The number of vessels engaged in the coasting trade is about 300,000, with an aggregate of about 10,500,000 tons; and the annual value of the trade is about £35,000,000.

A frontier trade of considerable extent is carried on, and probably this is the most ancient branch of Indian commerce. From time immemorial trading caravans have come down from the remote cities of Central Asia, through the Suliman passes, into the bazaars of the Punjab and other parts of India. The Punjab also conducts a considerable business *via* Cashmere with Yarkand, Kashgar, and Chinese Tibet, the chief marts on the side of India being Wauritsar and Jalandhar. Further east the independent state of Nepal cuts off direct intercourse with Tibet for a length of 700 miles bordering on the North-west Provinces, Oudh, and Behar. Though but little trade is allowed to filter through to Tibet, a large traffic is everywhere carried on along the frontier between the Nepalis and British subjects. Some trade is also done with the north-east frontier tribes, who almost surround the province of Assam from Bhutan to Manipur. The most important frontier business, however, is that carried on with Independent Burma, its value being nearly £4,000,000 out of the estimated total frontier trade of £7,750,000. This will be well understood by the fact that our possessions there include the whole of what was formerly the rather extensive Burmese sea-board.

The internal trade of India greatly exceeds her foreign

commerce, but it is impossible to estimate its amount. With unimportant exceptions free trade is the rule throughout the vast peninsula of India, by land as well as by sea, among the benefits which British rule has conferred being the removal of the internal duties and other restraints which native despotism had imposed upon trading energies. Generally speaking, the internal trade of a wholesale character remains in the hands of the natives. The Vaisyas, or trading caste, has now scarcely a separate existence; but its place is occupied by offshoots and well-marked classes.

We have already specified the leading productions of India, and the following table will show how far they enter into the commerce of the country:—

FOREIGN TRADE OF BRITISH INDIA IN 1883.

PRINCIPAL IMPORTS.		Quantities.	Value.
			£
Apparel,			769,752
Books and stationery,			625,431
Coals and coke,	tons	628,824	1,019,883
Cotton, twist and yarn,	lbs.	45,713,646	3,378,190
" manufactures,			21,431,872
Hardware and cutlery,			791,791
Liquors, Malt,	galls.	1,170,554	272,323
" Spirits,	"	949,169	674,969
" Wines, liqueurs, &c.,	"	418,169	387,822
Machinery and millwork,		—	1,342,398
Metals, Iron and steel,	tons	168,242	2,033,909
" Copper,	"	450,098	1,938,376
" Other sorts,			648,701
Oils,			1,050,897
Provisions,			1,087,186
Railway plant,			1,116,434
Salt,	tons	338,065	515,184
Silk, raw,	lbs.	2,386,150	1,074,156
" manufactures,	yds.	9,671,500	977,768
Spices,	lbs.	33,463,969	510,854
Sugar,	cwts.	672,672	1,086,961
Woollen goods,			984,873
Miscellaneous,			6,589,811
Total of merchandise,		—	50,003,041
Treasure,		—	13,453,157
Total merchandise and treasure,		—	63,456,198

PRINCIPAL EXPORTS.		Quantities.	Value.
			£
Coffee,	cwts.	364,008	1,419,131
Cotton, raw,		6,170,173	16,055,758
" twist and yarn,			1,874,464
" manufactures,			2,093,146
Grain—Rice,	cwts.	31,258,288	8,476,327
" Wheat,		14,193,763	6,088,814
" Other sorts,		1,165,826	819,571
Hides and skins,	No.	26,589,988	4,444,946
Indigo,	cwts.	141,041	3,912,997
Jute, raw,		10,348,909	5,846,926
" manufactures,		—	1,487,831
Lac (dye, shell, &c.),	cwts.	138,844	699,113
Opium,	chests	91,798	11,481,379
Seeds,	cwts.	13,147,982	7,205,924
Silk, raw,	lbs.	665,488	596,838
" manufactures,		—	306,928
Spices,	lbs.	20,947,105	417,391
Sugar, &c.,	cwts.	1,428,360	989,669
Tea,	lbs.	58,233,845	3,738,842
Wool, raw,		26,380,327	1,002,833
" manufactures,			183,348
Miscellaneous,			4,758,689
Total of all merchandise,			83,400,865
Indian produce or manuf.,			80,598,155
Foreign merchandise,			2,802,710
Treasure,			980,859
Total merchandise and treasure,			84,381,724

The local trade is conducted in the permanent bazaars of the great towns, at weekly markets in the rural villages, at annual gatherings held for religious purposes, or by means of travelling brokers and agents. The cultivator himself, who is the chief producer and also the chief customer, knows little of large cities, and expects the dealer to come to his own door. Each village has at least one resident trader, who usually combines in his own person the functions of money-lender, grain merchant, and cloth-seller. The simple system of rural economy is entirely based upon the dealings of this man, whom it is sometimes the fashion to decry as a usurer, but who is often the one thrifty person among an improvident population. If his rate of interest is high, it is only proportionate to the risks of his business. If he sometimes makes a merciless use of his legal position, the fault rests rather with the inflexible rules of our courts, which enable him to push the cultivators to extremes not allowed under native rule. Abolish the money-lender and the general body of cultivators would have nothing to depend upon but the harvest of the single year. The money-lender deals chiefly in grain and in specie.

In those districts where the staples of export are largely grown, the cultivators commonly sell their crops to travelling brokers, who re-sell to larger dealers, and so on until the commodities reach the hands of the agents of the great shipping houses. The wholesale trade thus rests ultimately with a comparatively small number of persons, who have agencies, or rather corresponding firms, at the central marts. Buying and selling, in their aspects most characteristic of India, are to be seen not in the large cities, nor even at the weekly markets, but at the fairs which are held periodically at certain spots in most districts. Religion is always the original cause of these gatherings or *melás*, at some of which nothing is done beyond bathing in the river or performing pious ceremonies. But in the majority of cases religion merely supplies the opportunity for secular business. Crowds of petty traders attend, bringing the medley of articles which can be packed into a peddler's wallet; and the neighbouring villagers look forward to the occasion to satisfy alike their curiosity and their household wants.

Manufactures.—The textile manufactures of India were famous in long-past centuries throughout the civilized world; such were the gold brocades of Delhi, brought thence to imperial Rome; the muslins of Dacca, made for the Mongol court, and the pattern-coloured cloths of Calicut (calico), the shawls of Cashmere, and the silks and carpets of Multan.

The Greeks of Alexander's expedition noticed that

garments of fine cotton were ordinarily worn by the great men of the country, either wrapped round the shoulders or enveloping the head as turbans; and the fine calicoes were among the most valuable of the wares brought home by the first ships of the old East India Company in 1601—cotton manufacture being at that time utterly unknown in England. In delicacy of texture, in purity and fastness of colour, and in grace of design, Indian cottons may still hold their own against the world; but in the matter of cheapness they have been unable to face the competition of Manchester, and these, together with most other local industries, have declined before the products of the great factories of England, which are now, as our table shows, largely introduced into the country. Despite these considerations, however, handloom weaving, as a village industry, is still carried on, with varying success, in many parts of India. If Manchester piece goods are cheaper, native piece goods are universally recognized as more durable; and it is estimated that about three-fifths of the cotton cloth used is woven in the country from native thread or from imported twist. In other respects Hindu wants are but few and simple, and are still to a large extent supplied by the native weaver, potter, blacksmith, or leather worker. India is decidedly an agricultural rather than a manufacturing country; but European enterprise has nevertheless established factories by means of which it is yet possible that imported goods may find formidable competitors. Already sixty cotton mills have been erected in Bombay, giving employment to more than 40,000 persons; while in Bengal twenty-two jute mills, with 4000 looms, are carrying on profitably an industry formerly entirely confined to Dundee. The extremely heavy cost of mill erection and transport of plant is a drawback to such enterprise, but not sufficiently to prevent its being moderately remunerative. Brewing has been established on a large scale at some of the hill stations, and with such remarkable success that the days of importing British beer to any great extent are probably numbered.

Communications.—Under British administration a system of internal communication has been rapidly developed, which in this respect places India nearly on a level with the most civilized regions of the globe. Apart from the natural channels of the great rivers and their affluents, which together afford more than 10,000 miles of navigable water highways, the irrigation canals, which are constantly increasing, are often navigable by small craft for hundreds of miles. Many of the larger canals have been specially adapted to this purpose, and by a wise provision have thus been made to serve a twofold object. The canals near Calcutta and in Orissa, and those of the Madras Presidency, are largely utilized in this way.

Although occupied for ages by settled communities, which had attained a high degree of culture long before Britain had emerged from barbarism, India seems to have possessed scarcely any roads before the advent of the English. Neither the ancient Hindu dynasties nor their Moslem conquerors paid any attention to this primary condition of true civilization. Many of the petty rulers were even directly opposed to the development of easy lines of communication, which would have the immediate effect of opening up the country to the attacks of hostile neighbours.

Now all this is changed, and although the system is still far from complete, over 20,000 miles of paved or macadamized highways have been constructed, mostly within the last fifty years. Thus all the great cities have been brought into direct communication with each other, and the uttermost limits of the land have been made accessible to the trader, the tourist, or for the marching of troops. Most of these highways are solidly constructed, and, like the railways, often present splendid specimens of engineering skill in their gradients, cuttings, causeways, and bridges.

Railway construction in India was proposed so far back as 1845, when the East Indian and Great Indian Peninsula railways were projected; but it was not until 1851 that operations were commenced on the latter line, nor until 1853 that the first 22 miles of railway were actually opened in the peninsula. After this preliminary delay the works proceeded slowly, delay being caused partly by the Sepoy mutiny, and partly by the natural difficulties in construction. The mutiny exhibited in a terribly prominent manner the urgent need of rapid means of communication, for want of which India was well-nigh lost to us. The lesson derived from the crisis impressed itself unmistakably upon the railway system. The government assumed the power of fixing the routes of all the lines, and the present railway system is mainly upon the plans laid down by Lord Dalhousie when governor-general. These provided in the first instance for a series of great trunk lines traversing the length and breadth of the peninsula, and connecting all the great cities and military cantonments. Without going into details, we may point out how this idea has been faithfully carried out by five great arteries of railway. The first and most northerly is from Calcutta for 1500 miles up the Ganges valley, through Allahabad and Lahore, and across the Indus at Attock to its present terminus at Peshawur on the Afghan frontier. By the Indus Valley line, branching off at Lahore, Calcutta is also placed in direct communication with Kurachee, the nearest port to England. The second great route is from Calcutta to Bombay, the line being formed by the junction of the southern branch of the East Indian Railway from Calcutta, and of the northern branch of the Great Indian Peninsula Railway from Bombay—the two lines meeting at Jubbulpur. The third great route is from Madras to Bombay, and consists of a junction at Raichore between the southern branch of the Indian Peninsula from Bombay and the northern branch of the Madras Railway. The fourth route is from Madras on the east to Beypur on the west coast, the whole distance being traversed by the Madras Railway. The fifth route is from Negapatam to Beypur, and is formed by the junction of the Great Southern of India Railway from Negapatam with the Madras and Beypur line at Errode. All the five routes are connected by one general system, so that communications for interchange of traffic between north and south, as well as from east and west, may be effected by them.

Primarily conceived with a view to their strategical importance, these routes have proved of immense value in a commercial sense; and they now form the base-work from which radiate one of the most useful and complete railway services in the world.

If government thus dictated the routes, it was only fair that some sort of guarantee should be given to insure a remunerative return for capital invested. The state accordingly offered two kinds of assistance—a qualified guarantee of interest upon capital, and a direct annual subsidy; both for a certain term of years. The guarantees were for the term of ninety-nine years from the dates of the contracts entered into between the government and the different companies; but the interest is only paid on the capital specially authorized to be raised by the government, and which has been expended according to its direction and under its inspection. When the railways are constructed and earn more than the guaranteed rate, they are to refund the money advanced by the government on their behalf, setting apart half of the excess profits above 5 per cent. for that purpose. The other form of government assistance to Indian railways—viz. an annual subsidy for twenty years—was a guarantee of about 2½ per cent. per annum upon lines of small average cost. Of late years, however, government itself has undertaken the direct construction of numerous railways.

As a further privilege to the Indian railways, it was arranged that any company might, after the railway had

been finished and in operation for three months at least, and at any time within ninety-nine years from the date of contract with the government, give six months' notice of their intention to relinquish the railway; and at the expiration of that time hand it over in good working order to the government, who would repay all authorized sums expended, subject to deduction of unsatisfied claims against revenue. On the other hand, the government has the power to purchase the railways at any time within six months, after twenty-five or fifty years, from the date of the several contracts with them. The price, in either case, is to be the mean value of the stock or shares for the three years previous to the surrender or purchase. The main East Indian line, from Calcutta to Peshawur, was in this way acquired by the state in 1880.

The great trunk lines throughout India are built on the broad gauge of 5 feet 6 inches, but Lord Mayo instituted a very useful policy of constructing narrower and less expensive lines, which should feed the larger, and thus open up the entire country. On this principle there has been a great development of traffic, some thousands of miles of narrow or metre gauge line of 3 feet $3\frac{3}{8}$ inches now penetrating and tapping districts of production which would have had to wait many years for the more expensive line. In all, in 1885 there were 11,000 miles of railway open for traffic in India, and 3500 sanctioned and awaiting construction. Most are single lines, there being only about 900 miles of double track. In 1883 the number of passengers carried amounted to 65,098,953, and of goods 17,089,264 tons. The gross receipts were £16,389,381, which gave an average profit of 5·91 per cent on the cost. This of course means that many of the lines paid remarkably well, inasmuch as some were never expected to be financially remunerative at all, having been constructed for other purposes. The tariff, for carriage both of passengers and goods, is considerably lower than in England.

Some of the engineering works connected with the Indian railways are among the finest in the world, especially the bridges and viaducts. Over the river Soane, on the East Indian line between Patna and Benares, a bridge has been thrown which is the longest in the world except only the Victoria, over the St. Lawrence, in Canada. It is about twice the length of the Charing Cross railway bridge over the Thames, and consists of twenty-seven iron girders of 150 feet each, supported on brick foundations. The great Indian Peninsula Railway crosses the Western Ghats, a range of lofty mountains, at the Bhore Ghat, near Callian. The length of the incline from the base to the summit is 15 miles 68 chains. The level of its base is 195 feet above the sea, and of its summit 2027 feet; the average gradient being one in forty-eight, and the steepest gradient one in thirty-seven, for one mile and $88\frac{1}{2}$ chains. Several of the embankments on this line exceed 60 feet in height; many of the outer slopes are 150 feet in length, and some of them as much as 300 feet. The total length of tunnels is more than $10\frac{1}{4}$ miles; and of the viaducts and vaulting arches about three-quarters of a mile. One viaduct consists of eight 50-feet arches, 143 feet from the surface. This immense work occupied seven years in its construction. Works of this character of course add largely to the cost of railways, and in the specially heavy cost of Indian lines must be remembered the exceptionally firm and substantial nature of the works required in districts liable to severe floods, and where large rivers, cutting their courses through soft and shifting soils, are apt to form new channels for themselves, sometimes miles away from their original beds.

Apart from the great advantages reaped by government from the railway system in the rapid conveyance of mails and troops, the increased value of land, and in the general development of trade, railways have brought to the people of India new ideas and intelligence. They have served to scatter prejudices and helped to break down caste. They have taught the benefit of interchange, not only of commodities, but of thought and sentiment. They have helped to mitigate the privations of famine and to save life by the transmission of food supplies, while a regular and rapid postal service has been established which is one of the cheapest in the world, the charge being uniform between the most extreme points of the peninsula.

Telegraphic and Postal Communication.—The electric telegraph has linked together all the principal cities and civil and military stations in India, and direct communication also exists with Europe. The postal communication extends over more than 60,000 miles; there are 10,000 post offices and receiving houses, and the number of letters and newspapers transmitted is upwards of 150,000,000 per annum. The rate of postage for any part within the limits of India is only half an anna, or $\frac{3}{4}d.$, for a single letter, which, considering distances, is lower than in any other country. There is a weekly communication between England and India, *via* the Suez Canal and Red Sea.

Constitution, Government, and Political Divisions.—The present form of government of the Indian Empire was established in 1858, when all the territories previously under the government of the East India Company were vested in her Majesty, and all its powers have since been exercised in her name. One of her Majesty's principal secretaries of state, called the secretary of state for India, is invested with all the powers before exercised by the company or by the Board of Control, and all warrants and orders under her Majesty's sign-manual must be countersigned by the same.

The executive authority in India is vested in a governor-general or viceroy, appointed by the crown, and acting under the orders of the secretary of state for India.

The administration of the Indian Empire is intrusted by the charter of 2nd August, 1858, and an Act passed in 1857, to a council of state for India. It is a purely consultative body, constituted for advising the secretary of state in the exercise of those powers of review and control which are the chief functions of the government at home. The major part of the council must consist of persons who have served or resided ten years in India; but the others may be gentlemen who, though without actual Indian residence and experience, from their general ability or knowledge of affairs may add to the weight and consideration of the body. No member of the council can sit or vote in Parliament. The salary of each is fixed at £1200 a year, payable, together with that of the secretary of state (£5000), out of the revenue of India.

The government in India is exercised by the council of the governor-general, consisting of five ordinary and one or two extraordinary members, the latter being the commander-in-chief and the governor of the presidency where the council may be sitting. The business of the government is conducted in five separate departments—financial, home, foreign, military, and public works; each department is under the charge of a secretary, and each is besides the special care of a member of the supreme council. There is, besides, a legislative council, consisting of twelve members, of whom one-half must be unconnected with the public service. The six official members are civilians of experience, chosen from different parts of the country; as non-official members two leading Calcutta merchants are generally appointed, and four natives of rank, also chosen from different parts of the country. The debates are open to strangers, and the governor-general has the power of veto over all measures passed. The governor-general of India holds the highest office in the world filled by an uncrowned head. He is appointed by the crown for a term of about six years, with a salary of £30,000 per annum, a palace and establishment at Calcutta, and a country residence at Simla.

The following is a list of the governors-general of India, with the dates of their appointments:—

Warren Hastings, .	1772	Lord Auckland, .	1835
Sir J. M'Pherson, . .	1785	Lord Ellenborough,	1842
Earl (Marquis) Cornwallis, ...	1786	Sir H. (Lord) Hardinge,	1844
Sir J. Shore, . . .	1793	Earl Dalhousie,	1847
Lord Mornington, .	1798	Lord Canning, .	1855
Marquis Cornwallis, .	1805	Lord Elgin, .	1862
Sir G. Barlow, . . .	1805	Sir John (Lord) Lawrence, . . .	1863
Earl of Minto, . . .	1807	Earl of Mayo, . .	1868
Earl Moira (Marquis of Hastings), . .	1813	Lord Northbrook, .	1872
Earl Amherst, . . .	1823	Lord Lytton, . .	1876
Lord W. Bentinck, .	1828	Marquis of Ripon,	1880
		Lord Dufferin, . .	1884

For ordinary purposes of administration India is divided into several presidencies or provinces, each with a government of its own, and certain of the native states are attached to those provinces with which they are most nearly connected geographically. Bengal with its lieutenant-governor, and Bombay and Madras with their governors, are great provinces, each with an executive and a legislative council. The North-west Provinces and the Punjab are administered by single officials with the title of lieutenant-governor. Assam, British Burma, and the Central Provinces are under chief commissioners; while Ajmere, Berar, Coorg, and the Andaman Islands are districts under the immediate control of the viceroy. The lieutenant-governors and other principal officers are chosen chiefly from the "covenanted civil service" of India. This service is composed chiefly of Europeans, who conduct the general administration of British India, and whose salaries vary from £300 to £8000 per annum. It consists of about 1000 members. The staff is recruited from successful candidates at open competitive examinations instituted for the purpose in England. In the "uncovenanted civil service" the appointments are made by the authorities in India. It is composed of Europeans, Eurasians (the class sprung from native mothers by European fathers), and natives, with salaries of from £12 to £3000 per annum. It consists of nearly 7000 members, of whom about 2500 are natives.

Municipal government was introduced some years since into the three presidency towns of Calcutta, Madras, and Bombay, and has since been extended very widely to various parts of India. The privilege of electing their own managers of local affairs is much prized by the people, who raise no objection to the local rates or octroi duties necessary for administration.

In addition to the territory directly ruled by the governor-general, there are in India a considerable number of states which are allowed to remain under the sway of native princes, so long as these maintain order and justice and are loyal to the supreme power. In all no less than 460 native states acknowledge the supremacy of the British government. With some this bare acknowledgment is all that is yielded; others have pledged themselves to follow the advice of the viceroy; others pay tribute or maintain a military contingent at their own cost; some have power of life and death; while others must refer all grave cases to English judges. In the case of failure of heirs, none can exercise the right of adoption without an express grant from the paramount power; and the greatest of them, when admitted to the presence of the viceroy, presents his *nuzzur* or present, which is throughout the East the acknowledged mark of inferiority. They may not levy war against one another, while a guarantee for internal order exists in the right of dethronement and the establishment of a temporary British administration, which has not seldom been exercised; perhaps the most important case in recent years being that of the Guicowar of Baroda, in 1875.

There is a wide difference in the extent of the native states. The most important are the ancient Hindu states of Rajputana, which cover 129,750 square miles, and contain a population of 10,268,392; Hyderabad, or the dominions of the Nizam, the first Mohammedan potentate in the peninsula, area 81,807 square milas, population 9,845,594; the three great Marhatta states, Baroda, Gwalior, and Indore, ruled over respectively by the Guicowar, Sindhia, and Holkar, with a total area of 45,593 square miles, and a population of 5,000,000; the Himalayan valley of Cashmere, whose chief owes his power to the British, area 79,784 square miles, population 1,537,000; and the flourishing states of Travancore and Cochin, area 8091 square miles, population 2,909,732. The total revenue of all the chiefs is estimated at £14,500,000 sterling; the tribute they pay to the British is only £700,000. On the other hand, some chieftains whose independence is recognized are mere heads of wild hill tribes, others are really subject noblemen or squires, while those above-named possess most of the attributes of independent sovereignty.

The English population amounts to about 180,000 persons, including the 63,000 British troops, the large number of civilians in the public service, and about 25,000 females.

Army.—The army of the old East India Company consisted of both natives and Europeans; the former, however, largely preponderated. Just previous to the mutiny the East Indian army consisted of about 300,000 native troops and 40,000 Europeans, of whom a large proportion were employed as officers in the Sepoy regiments. There were a greater number of English officers to each native regiment than there are at present, but this single advantage was heavily purchased by the fact that the solid phalanx of English troops was then only as one to nine, instead of being now as one to two, while the artillery, which, with a few unimportant exceptions, is now exclusively European, was then mainly composed of native batteries. The temptation to revolt as soon as a sufficiently strong inducement presented itself was practically irresistible under the old condition of things; but under the present arrangement any general mutiny is not merely highly improbable, but may be considered, practically speaking, impossible.

The necessities of the mutiny campaign caused the increase of the English garrison from 40,000 men to about 100,000 men, to which number the English forces had attained when Lord Clyde brought the operations in Oudh to a triumphant conclusion with the capture of Lucknow. But as the new native army began to take form, and when the European troops of the company were disbanded, this force was also gradually reduced, until in 1867 only 65,000 Europeans were left; and then many of our best military authorities raised a note of warning and declared that it had reached "the lowest point compatible with safety." The European garrison has fluctuated about that figure ever since, at one time being something more, and at another somewhat less than that number. The British troops in India form part of the queen's army generally, but their cost is defrayed out of the Indian, not the English revenues. According to the army estimates of 1885–86 the European force was then as follows:—

	Officers.	N.-commis'ned Officers.	Rank and File	All Ranks.
Cavalry of the Line, . .	198	360	3,726	4,284
Royal Artillery, . . .	436	669	10,140	11,262
Royal Engineers, . . .	436	3	—	439
Infantry of the Line, .	1,400	2,302	41,810	45,507
Total, ...	2,487	3,334	55,676	61,492

The total garrison of India shows, therefore, a force of some 60,000 Englishmen and about 130,000 natives, with a formidable array of artillery. The distribution of this force is such that there is a garrison of more than 50,000 men in the Punjab alone, and the most efficient regiments are those stationed in this province. They consist of the most warlike races in Northern India—Sikhs, Goorkhas, Jats, Pathans, and other natives of the "land of the five rivers." Many of these regiments have shown no small degree of courage and military proficiency in the many frontier wars which have been fought since the annexation of the Punjab; and several of the Sikh and Goorkha regiments behaved with exemplary fortitude on more than one occasion in Afghanistan. The line of the Ganges is held in considerable strength, and a succession of fortified positions rest with their centre on Allahabad, where the railways of the north-west and the south-west join with those to the east. Twenty thousand men are permanently employed in this work, which includes the garrisoning of the large cities of Calcutta, Lucknow, Benares, and Patna. Five-and-twenty thousand men occupy Central India, and are supposed to neutralize the armies of Indore, Gwalior, and Rajputana. A special army is assigned and maintained at great cost for the tranquillity of Hyderabad. The army of Bombay also has many duties to perform, and the advance to Quettah and the assertion of our authority in Kelat have increased its opportunities of activity. A separate force, first organized more than thirty years ago by General John Jacob, has been intrusted with the defence of the Sind frontier, similar to that created for the same work on the Punjab, although on a smaller scale. An enormous population has everywhere to be impressed with the sense of the invincible military power on which the fabric of our authority has been erected. The tendency to riot, which always exists where a variety of races who are hostile to each other by tradition and by religious antipathy have to live side by side without a chance of indulging their rivalries, has to be rigorously repressed by a skilful display of the force which is ever ready to check the first civil disturbance and to punish the offenders.

The division of the native army differs in more than one respect from the European. The most striking feature is the almost complete absence of artillery. The regiments of Bengal and Bombay cavalry are mounted on what is known as the Silladar system—that is, the men provide their own horses, for which government allow compensation of about 200 rupees if killed in action or during service. In return for providing his horse the sowar or trooper receives a monthly pay of 27 rupees in Bengal and of 30 rupees in Bombay. The Madras cavalry comes under a different system, and is mounted by government; as a consequence the sowar's pay there is very much less, being only 9 rupees a month. There has hitherto been less difficulty in recruiting the regiments under the Silladar system, and those of the greatest efficiency in the native army are composed of men whose horses are their own property, who take a personal pride in their well-being, and who recall in their character the men-at-arms of the middle ages. The annual cost of the Indian army in recent years has varied from £14,000,000 to £20,000,000, but it may be taken on an average to be £16,000,000.

Since 1863 the Indian government have endeavoured to provide healthy permanent barracks for the whole army, a matter which had become one of paramount importance. Sea-side convalescent stations and hill sanitariums have been established, the expense of the whole up to 1885 amounting to more than £12,000,000. Many of the old objections to service in India have thus been removed, and the health of the army generally has improved.

Armies in the Native States.—An important question was raised before the Afghan war of 1878–80 took place, and will doubtless arise again upon any temporary cause of disturbance—viz. why so large a military force should be maintained by us in India at a cost which proves most cruelly burdensome to the country. The primary cause is not far to seek. We have shown that within the limits of India there is a vast conglomeration of native or feudatory states, the total extent of which is larger than the entire area of France, the German Empire, and Italy combined, with a population in all of nearly 50,000,000. The privileges enjoyed by these semi-independent states include the maintenance, to a certain extent, of standing armies. In most instances, however, the permitted limits have been largely exceeded, with little if any restraint by the dominant power. Gwalior, for instance, maintains an army of 22,000 men and 210 guns, although by treaty its prince is only empowered to maintain a force of 5000 men and thirty-six guns. Both in Gwalior and some other of the native states the military are organized on the Prussian system of short service, so that really the numbers of the native forces are only limited by the men available for service. The actual numbers of the armies kept up in the native states are as follows:—

	Cavalry.	Infantry.	Guns.
Rajputana States, . . .	23,937	68,843	1980
Western India, . . .	6,585	28,408	834
Central India, ...	14,204	51,369	821
Southern India, . . .	8,397	39,601	740
Cis-Sutlej States, . . .	9,444	49,480	646
Total, ...	62,567	237,701	5021

This gives a total force of 300,268 men and 5021 guns; and the general testimony is that the men are as a rule fairly drilled, disciplined, and equipped. The quality of the fighting material is best attested by the splendid service many of the loyal native levies rendered us before Delhi and on other critical occasions during the mutiny. On the other hand, taking the native armies as a whole, they cannot but be a lively source of anxiety to any governor-general, as several of the more powerful native rulers never cease to deplore what they regard as a humiliating loss of prestige imposed upon them by the restraints of the overawing British power. It becomes, in consequence, one of the principal duties of our own Indian army to watch the movements of the native forces. The Hyderabad army of 45,000 men and 725 guns necessitates a corps of observation consisting of 12,000 British and native troops; while the powerful British cantonments of Morar and Jhansi were up to 1885 held avowedly to check the warlike proclivities of the late Maharajah Sindhia. But in that year his national fortress of Gwalior was restored to him, on the advice of Lord Dufferin, as a recognition of the support he had offered the British Government when war with Russia appeared imminent on the Afghan frontier dispute.

With the consolidation of our empire in Hindustan all danger to these potentates of invasion from without ceased. Their differences and ancient feuds were also settled. The strong arm of England stepped in, not only to compel them to keep the peace to each other, but also to guarantee them from those periodical waves of aggression which, ever and anon bursting upon India through the passes of the Suliman Mountains, swept the continent from shore to shore. Being thus secure from war, it is obvious that the necessity for the retention of their standing armies ceased. A small personal grant for state purposes would have answered all requirements, and this is all that should, in justice to the people of the country, have been allowed them. It is, however, idle to cast vain regrets over the past; but it is clear that at the close of the mutiny,

when we stood triumphant on the neck of India with about 80,000 seasoned campaigners in the field, there was an admirable opportunity for laying down a hard and fast rule that the only standing army in the country should be the British, and that the forfeiture of his rights would be the penalty of any prince endeavouring to evade the rule.

Although, however, an opportunity was then lost, the evils arising from the existing state of things are so great that, in justice to the people of India, a remedy will have to be applied at no distant day. The expense of keeping up a fighting force of some 500,000 men (including our own and the native armies) constitutes a most deplorable burden for a country so poor as India; while the diversion of most of the men from warlike to their legitimate agricultural pursuits would be a benefit far too great to be reckoned at any mere money value. The standing menace of an army of 300,000 men in our midst, yet not of us, can only be regarded as a slumbering volcano which may at any time overwhelm India in a disaster more terrible than it has ever yet known, and all sense and justice demand the removal of this effective hindrance to the peaceful development of the great resources and capacities of the country. When such removal takes place it will be easy to decide how far our own forces might be reduced; for in the first place the necessity for the Hyderabad contingent, for many of the heavy local corps in Central India, and for the strong garrisons of Agra, Gwalior, Umballah, and Jullundur would in a great measure pass away—all these portions of our army being maintained almost wholly as corps of observation upon the levies of the native states. The Indian military expenses have in some years amounted to the whole sum of the land tax, and if a few millions of this outlay could be applied to further extensions of the railway system India would benefit by profitable public works, while the increased ability to move a portion of the army swiftly upon any given position would enable that force to be with safety reduced to a minimum.

The *Indian Police* now forms a very important and useful force. It is modelled on one uniform system, with a central organization in each presidency. It consists altogether of 160,000 men of different races, and is officered largely by Europeans. In addition to the regular organized police there are about 360,000 village police or watchmen.

There is now no separate *Navy* for India, but a pilot service is still maintained.

Law and Administration of Justice.—In 1861 the supreme court at Calcutta and the Sudder Mofussil, or country courts, were abolished, and high courts of judicature were established in each presidency and in the North-west Provinces, under the control of a chief-justice and as many other judges, not exceeding fifteen, as her Majesty may appoint. These high courts exercise civil, criminal, admiralty, testamentary, intestate, and matrimonial jurisdiction, original and appellate, by single judges or by division courts; so that the verdicts of the inferior courts may be submitted to men of high legal knowledge.

In 1872, after a labour occupying several years, Mr. J. Fitzjames Stephen completed a work of immense public utility and importance, namely, the consolidation, abbreviation, and simplification of the Indian statutes. Previous to the commencement of this task there existed a chaos of enactments, cases, and opinions which seemed to baffle the power of man to reduce to anything like certainty. Indeed, to such proportions had the enactments grown that, on the conquest of the Punjab and Oudh, no attempt was made to introduce into the new territories the existing law of India, and every attempt subsequently made to introduce it resulted in the most embarrassing confusion. India now, however, possesses both civil and criminal codes of statutes of extreme simplicity, and which are introduced and acted upon without difficulty in the wildest districts.

Aboriginal Races of India.—European writers formerly divided the Indian population into two races—the Hindus and the Mohammedans. But when we look more closely at the people, we find that they consist of four well-marked elements. These are, first, the recognized non-Aryan tribes, sometimes called the aborigines, and their half-Hinduized descendants, numbering 18,000,000; second, the comparatively pure offspring of the Aryan or Sanskrit-speaking race (the Brahmans and Rajputs), about 16,000,000; third, the great mixed population, generally known as the Hindus, which has grown out of the Aryan and non-Aryan elements (chiefly from the latter), and now numbers 110,000,000; fourth, the Mohammedans, 41,000,000. These make up the 186,000,000 people under British rule. The same fourfold division applies to the population of the 54,000,000 in feudatory India, but the numbers of the different classes are not known.

Our earliest glimpses of India disclose two races struggling for the soil. The one was a fair-skinned people, which had lately entered by the north-western passes; a people of ARYAN (literally "noble") lineage, speaking a stately language, worshipping friendly and powerful gods. The other was a race of a lower type, who had long dwelt in the land, and whom the lordly new-comers drove back before them into the mountains, or reduced to servitude on the plains. The comparatively pure descendants of these two races are now nearly equal in numbers; the intermediate castes, sprung chiefly from the ruder stock, make up the mass of the present Indian population.

The lower tribes were an obscure people who, in the absence of a race-name of their own, may be called the non-Aryans or aborigines. They have left no written records; indeed, the use of letters, or of the simplest hieroglyphics, was unknown to them. The sole works of their hands which have come down to us are rude stone circles, and the upright slabs and mounds, beneath which, like the primitive peoples of Europe, they buried their dead. From these we only discover that, at some far-distant but unfixed period, they knew how to make round pots of hard, thin earthenware, not inelegant in shape; that they fought with iron weapons, and wore ornaments of copper and gold. Coins of imperial Rome have been dug up from their graves. Still earlier remains, found in the upper soils of large areas, prove, indeed, that these ancient tomb-builders formed only one link in a chain of primeval races. Long before their advent India was peopled as far as the Central Provinces by tribes unacquainted with the metals, who hunted and warred with polished flint axes and other deftly wrought implements of stone, similar to those found in Northern Europe. And even these were the successors of yet ruder beings, who have left their agate knives and rough flint weapons in the Nerbudda valley. In front of this far-stretching background of the early metal and stone ages, we see the so-called aborigines being beaten down by the newly arrived Aryan race.

The primitive races of India, thrust back by the Aryans from the plains, have lain hidden away in the recesses of the mountains, like the remains of extinct animals which palæontologists find in hill caves. India thus forms a great museum of races, in which man can be studied from his lowest to his highest stages of culture.

Among the rudest fragments of mankind are the isolated Andaman islanders in the Bay of Bengal. See ANDAMAN ISLANDS.

The Anamalai Hills, in Southern Madras, form the refuge of a whole series of broken tribes. Five hamlets of long-haired, wild-looking Puliars live on jungle products, mice, or any small animals they can catch, and worship demons. Another clan, the Mundavers, shrink from contact with the outside world, and possess no fixed dwellings, but wander over the innermost hills with their cattle, sheltering themselves under little leaf sheds, and seldom

remaining in one spot more than a year. The thick-lipped, small-bodied Kaders, lords of the hills, are a remnant of a higher race. They file the front teeth of the upper jaw as a marriage ceremony, live by the chase, and wield some influence over the ruder forest folk. These hills, now almost uninhabited, abound in the great stone monuments (kistvaens and dolmens) which the primitive tribes erected over their dead. The Nairs, or hillmen of South-western India, still practise polyandry, according to which one woman is the wife of several husbands, and a man's property descends not to his own but to his sister's children. This system also appears among the Himalayan tribes at the opposite extremity of India.

In the Central Provinces the aboriginal races form a large proportion of the population. In certain districts, as in the feudatory state of Bastar, they amount to three-fifths of the inhabitants. Their most important race, the Gonds, have made some advances in civilization; but the wilder tribes still cling to the forest, and live by the chase. The Marias wield bows of great strength, which they hold with their feet while they draw the string with both hands. A still wilder tribe, the Maris, fly from their grass-built huts on the approach of a stranger. Once a year a messenger comes to them from the local rajah to take their tribute, which consists chiefly of jungle products. He does not, however, enter their hamlets, but beats a drum outside, and then hides himself. The shy Maris creep forth, place what they have to give in an appointed spot, and run back again into their retreats.

Proceeding to the northern boundary of India, we find the slopes and spurs of the Himalayas peopled by a great variety of rude tribes. Some of the Assam hillmen have no word for expressing distance by miles nor any land-measure, but reckon the length of a journey by the number of plugs of tobacco or *pan* which they chew upon the way. As a rule they are fierce, black, undersized, and ill-fed. They eked out a wretched subsistence by plundering the more civilized hamlets of the Assam valley—a means of livelihood which they have now abandoned.

Many of the aboriginal tribes, therefore, remain in the same early stage of human progress as that ascribed to them by the Vedic poets more than 3000 years ago. But others have made great advances, and form communities of a well-developed type. These higher races, like the ruder ones, are scattered over the length and breadth of India. The Santals and the Kandhs inhabit the north-eastern edge of the great central plateau. The Santals have their home among the hills which abut on the valley of the Ganges in Lower Bengal. The Kandhs live about 200 miles to the south, on the spurs and ridges which look down upon the Orissa delta and Madras coast.

The Santals dwell in villages in the jungles or among the mountains, apart from the people of the plains. They number about 1,000,000, and give their name to a large district, the Santal Parganas, 140 miles north-west of Calcutta. Although still clinging to many customs of a hunting forest tribe, they have learned the use of the plough and settled down into skilful husbandmen. Each hamlet is governed by its own head-man, who is supposed to be a descendant of the original founder of the village, and who is assisted by a deputy head-man and a watchman. The boys of the hamlet have their separate officers, and are strictly controlled by their own head and his deputy till they enter the married state. The Santals know not the distinctions of Hindu caste, but trace their tribes, usually fixed at seven, to the seven sons of the first parents. The whole village feasts, hunts, and worships together; and the Santal must take his wife, not from his own tribe, but from one of the six others. So strong is the bond of race that expulsion from the tribe was the only Santal punishment. A heinous criminal was cut off from fire and water in the village, and sent forth alone into the jungle.

The Santal has no conception of bright and friendly gods, such as the Vedic singers worshipped. Still less can he imagine one omnipotent and beneficent deity, who watches over mankind. Hunted and driven back before the Hindus and Mohammedans, he does not understand how a Being can be more powerful than himself without wishing to harm him. "What," said a Santal to an eloquent missionary, who had been discoursing on the Christian God, "what if that strong One should eat me?" Nevertheless, the earth swarms with spirits and demons whose ill-will he tries to avert. His religion consists of nature-worship and offerings to the ghosts of his ancestors, and his rites are more numerous even than those of the Hindus.

Until nearly the end of the last century, the Santals were the pests of the neighbouring plains. Regularly after the December harvest they sallied forth from their mountains, plundered the lowlands, levied blackmail, and then retired with their spoil to their jungles. But in 1789, the British government granted the proprietary right in the soil to the landholders of Bengal under the arrangements which four years later became the permanent settlement. Forthwith every landholder tried to increase the cultivated area on his estate, now become his own property. The Santals and other wild tribes were tempted to issue from their fastnesses by high wages or rent-free farms.

The Kandhs (literally "the mountaineers"), a tribe about 100,000 strong, inhabit the steep and forest-covered ranges which rise from the Orissa coast. They form one of a group of non-Aryan races who still occupy the positions assigned to them by the Greek geographers 1500 years ago. Before that early date they had been pushed backwards by the advancing Aryans from the fertile delta which lies between the mountains and the sea. One section of the Kandhs was completely broken up, and has sunk into landless low castes among the Aryan or Hindu communities at the foot of the hills. Another section stood its ground more firmly, and became a peasant militia, holding grants of land from the Hindu chiefs in return for military service. A third section fell back into the fastnesses of the mountains, and was recognized as a wild but free race. The Kandh idea of government is purely patriarchal. The family is strictly ruled by the father. The grown-up sons have no property during his life, but live in his house with their wives and children, and all share the common meal prepared by the grandmother. The clan consists of a number of families sprung from a common father; and the tribe is made up in like manner from a number of clans who claim descent from the same ancestor. The head of the tribe is usually the eldest son of the patriarchal family; but if he be not fit for the post he is set aside, and an uncle or a younger brother appointed. He enters on no undertaking without calling together the heads of clans, who in their turn consult the heads of families. According to the Kandh theory of existence, a state of war might lawfully be presumed against all neighbours with whom no express agreement had been made to the contrary. Murders were punished by blood-revenge, the kinsmen within a certain degree being one and all bound to kill the slayer, unless appeased by a payment of grain or cattle. The man who wounded another had to maintain the sufferer until he recovered from his hurt. A stolen article must be returned, or its equivalent paid; but the Kandh twice convicted of theft was driven forth from his tribe, the greatest punishment known to the race. Disputes were settled by combat, or by the ordeal of boiling oil or heated iron, or by taking a solemn oath on an ant-hill, or on a tiger's claw, or a lizard's skin. When a house-father died leaving no sons, his land was parcelled out among the other male heads of the village; for no woman, nor indeed any Kandh, was

allowed to hold land who could not with his own hand defend it.

Some of these ancient races are dying out, such as the Andaman islanders, among whom only one family in 1869 had as many as three children. Others are increasing, like the Santals, who have doubled themselves under British rule. But they all require special and anxious care in adapting our complex administration to their primitive condition and needs. Taken as a whole, and including certain half-Hinduized branches, they number 18,000,000. But while the bolder or more isolated of the aboriginal races have thus kept themselves apart, by far the greater portion submitted in ancient times to the Aryan invaders, and now make up the mass of the Hindus.

The aboriginal races on the plains have supplied the hereditary criminal classes, alike under the Hindus, the Mohammedans, and the British. Formerly organized robber communities, they have, under the stricter police of our days, sunk into petty pilferers. The non-Aryan hill races, who appear from Vedic times downwards as marauders, have at length ceased to be a disturbing element in India. Many of them figure as predatory clans in Mohammedan and early British history. They sallied forth from their mountains at the end of the autumn harvest, pillaged and burned the lowland villages, and retired to their fastnesses laden with the booty of the plains. The measures by which these wild races have been reclaimed form some of the most honourable episodes of Anglo-Indian rule. Their character differs in many respects from that of the tamer population of the plains. Their truthfulness, sturdy loyalty, and a certain joyous bravery, almost amounting to playfulness, appeal in a special manner to the English mind.

Every military man who has had anything to do with the aboriginal races acknowledges that once they admit a claim on their allegiance nothing tempts them to a treacherous or disloyal act. "The fidelity to their acknowledged chief," writes Captain Hunter, "is very remarkable; and so strong is their attachment that in no situation or condition, however desperate, can they be induced to betray him."

The short incursion of Alexander the Great, B.C. 325, and contact with the Bactrian kingdom founded by his successors, seem to have given no new element to the population, but it was not so with the invasions which followed; the Semitic and Mongolian races and a new Aryan element were introduced in the successive inroads and conquests of the Afghans and Persians, of Zenghis Khan and Tamerlane, and on the expulsion of the Guebres or fire-worshippers from Persia, when that nation embraced the doctrines of Islam. These last are confined to Western India, and are called Parsees, that is, Persians. The Semitic and Aryan elements are strengthened by the settlement of many Jews, Arabs, and Armenians. There are a few Chinese in the eastern cities.

In the north the people are generally tall and fair, manly and warlike; in the Deccan and Bengal, small and dark, timid and superstitious. The many diversities which exist no doubt arise from local circumstances—food, institutions, and various intermixtures among themselves. The women, except among the most exposed castes, are well formed and graceful in person, with good features, soft polished skins, dark expressive eyes, and fine dark hair. The Hindu complexion generally varies from a deep olive to a beautiful transparent brown, like the natives of Northern Italy.

The *Aryan race* belonged to the splendid ARYAN or Indo-Germanic stock, from which the Brahman, the Rajput, and the Englishman alike descend. Its earliest home seems to have been in Central Asia. From that common camping-ground certain branches of the race started for the east, others for the west.

The Aryan offshoots to the east and to the west alike asserted their superiority over the earlier peoples whom they found in possession of the soil. The history of ancient Europe is the story of the Aryan settlements around the shores of the Mediterranean; and that wide term modern civilization merely means the civilization of the western branches of the same race. The history and development of India consist, in like manner, of the history and development of the eastern offshoots of the Aryan stock who settled in that land. In the west the Aryan speech has supplied the modern languages of Europe, America, and England's island empires in the Southern Pacific. In the east Hinduism and Buddhism, the two religions of the Indian branch of the Aryans, have become the faiths of more than one-half of the whole human race, and spread Aryan thought and culture throughout Asia to the utmost limits of China and Japan.

The forefathers of the Greek and the Roman, of the Englishman and the Hindu, dwelt together in Asia, spoke the same tongue, worshipped the same gods. The languages of Europe and India, although at first sight they seem wide apart, are merely different growths from the original Aryan speech. This is especially true of the common words of family life. The names for father, mother, brother, sister, and widow are the same in most of the Aryan languages, whether spoken on the banks of the Ganges, of the Tiber, or of the Thames. Thus the word *daughter*, which occurs in nearly all of them, has been derived from two Sanskrit roots meaning "to draw milk," and preserves the memory of the time when the daughter was the little milkmaid in the primitive Aryan household.

The Vedic hymns exhibit the Indian branch of the Aryans on their march to the south-east and in their new homes. As their numbers increased they pushed eastwards along the base of the Himalayas, into what they afterwards called the Land of the Sacred Singers (*Brahmarshidesha*). Their settlements included by degrees the "five rivers" of the Punjab, together with the other great river-system formed by the upper courses of the Jumna and the Ganges. Here the Vedic hymns were composed; and the steady supply of water led the Aryans to settle down from their old state of wandering pastoral tribes into communities of husbandmen. The Vedic poets praised the rivers which enabled them to make this great change—perhaps the most important step in the progress of a race. "May the Indus," they sang, "the far-famed giver of wealth, hear us; [fertilizing our] broad fields with water." The Himalayas, through whose offshoots they had reached India, and at whose southern base they long dwelt, made a lasting impression on their memory. The Vedic singer praised "Him whose greatness the snowy ranges, and the sea, and the aerial river declare." In all its long wanderings through India the Aryan race never forgot its northern home. There dwelt its gods and holy singers, and their eloquence descended from heaven among men; while beyond the mountain-wall lay the paradise of deities and heroes, where the kind and the brave for ever repose.

The Rig-Veda forms the great literary memorial of the early Aryan settlements in the Punjab. The age of this venerable hymnal is unknown. The Hindus believe, without evidence, that it existed "from before all time," or at least from 3001 years B.C., nearly 5000 years ago. European scholars have inferred from astronomical dates that its composition was going on about 1400 B.C. The Vedic hymns seem to have been composed by certain families of Rishis or psalmists, some of whose names are preserved. The Rig-Veda is a very old collection of 1017 of these short lyrical poems, chiefly addressed to the gods, and containing 10,580 verses. They show us the Aryans on the banks of the Indus, divided into various tribes, sometimes at war with each other, sometimes united against the "black-skinned" aborigines. Caste, in its later sense, is unknown. Each father of a family is the priest of his own household. The chieftain acts as father and priest to

the tribe; but at the greater festivals he chooses some one specially learned in holy offerings to conduct the sacrifice in the name of the people. Women enjoyed a high position, and some of the most beautiful hymns were composed by ladies and queens. Marriage was held sacred. Husband and wife were both "rulers of the house" (*dampati*), and drew near to the gods together in prayer. The burning of widows on their husbands' funeral-pile was unknown; and the verses in the Veda which the Brahmans afterwards distorted into a sanction for the practice have the very opposite meaning. "Rise, woman," says the sacred text to the mourner; "come to the world of life. Come to us. Thou hast fulfilled thy duties as a wife to thy husband."

Unlike the modern Hindus, the Aryans of the Veda ate beef, used a fermented liquor or beer made from the *soma* plant, and offered the same strong meat and drink to their gods. Thus the stout Aryans spread eastwards through Northern India, pushed on from behind by later arrivals of their own stock, and driving before them or reducing to bondage the earlier "black-skinned" races. They marched in whole communities from one river-valley to another, each house-father a warrior, husbandman, and priest, with his wife and his little ones and cattle.

Aryan Mythology: the Rig-Veda.—These free-hearted tribes had a great trust in themselves and their gods. Like other conquering races, they believed that both themselves and their deities were altogether superior to the people of the land and their poor rude objects of worship. Indeed, this noble self-confidence is a great aid to the success of a nation. Their divinities (*devas*, literally "the shining ones," from the Sanskrit root *div*, to shine) were the great powers of nature. They adored the father-heaven (*Dyaash-pitar* in Sanskrit, the *Dies-piter* or *Jupiter* of Rome, the *Zeus* of Greece, the Low German *Duus*, and, through the Old French god-demon, *Dus-ius*, probably the *Deuce* of English slang), together with mother-earth and the encompassing sky (*Varuna* in Sanskrit, *Uranus* in Latin, *Ouranos* in Greek). "Let me not yet, O Varuna, enter the house of clay" (the grave), says a Rig-Vedic hymn! "have mercy, almighty, have mercy! If I go along trembling, like a cloud driven by the wind, have mercy, almighty, have mercy! Through want of strength, thou strong and bright god, have I gone wrong; have mercy, almighty, have mercy!" Indra, or the aqueous vapour that brings the precious rain on which plenty or famine still depends each autumn, received the largest number of hymns. By degrees, as the settlers realized more and more keenly the importance of the periodical rains to their new life as husbandmen, he became the chief of the Vedic gods. "The gods do not reach unto thee, O Indra, or men; thou overcomest all creatures in strength." Agni, the god of fire (Latin *igni-s*), ranks perhaps next to Indra in the number of hymns addressed to him as "the youngest of the gods," "the lord and giver of wealth." The Maruts are the storm gods, "who make the rocks to tremble, who tear in pieces the forest." Ushas, the high-born dawn (Greek *Eos*), "shines upon us like a young wife, rousing every living being to go forth to his work." The Aswins, or "fleet outriders" of the dawn, are the first rays of sunrise, "lords of lustre." The solar orb himself (Surjya), the wind (Vayu), the sunshine or friendly day (Mitra), the animating fermented juice of the sacrificial plant (Soma), and many others are invoked in the Veda; in all about thirty-three gods, "who are eleven in heaven, eleven on earth, and eleven dwelling in glory in mid-air."

The terrible blood-drinking deities of modern Hinduism are scarcely known in the Veda. Buffaloes are indeed offered, and one hymn points to a symbolism based on human sacrifices, an early practice apparently extinct before the time of the Vedic singers. The great horse-sacrifice seems a substitution for the flesh and blood of a man. But as a whole the hymns are addressed to bright, friendly gods. Rudra, who was destined to become the Siva of the Hindus, and the third person or destroyer in their triad, is only the god of roaring tempests in the Veda; Vishnu, the second person or preserver in the Hindu triad, is but slightly known as the deity of the shining firmament; while Brahma, the first person or creator, has no separate existence in these simple hymns. The names of the dreadful Mahadeva, Durga, Kali, and of the gentler Krishna and Rama, are alike unknown in the Rig-Veda.

The Aryan settlers lived on excellent terms with their bright gods. They asked for protection with an assured conviction that it would be granted. The sense of sin or the idea of spiritual submission scarcely appears in the Veda. "Give me cows, or land, or long life, in return for this hymn or offering;" "slay my enemy, scatter the black-skin, and I will sacrifice to thee"—such is the ordinary frame of mind of the singer to his gods. But at the same time he was deeply stirred by the glory and mystery of the earth and the heavens. Indeed the majesty of nature so filled his mind that when he praises any one of his shining gods he can think of none other for the time being, and adores him as the supreme ruler. Verses may be quoted declaring each of the greater deities to be the one supreme: "Neither gods nor men reach unto thee, O Indra;" Soma is "king of heaven and earth, the conqueror of all." To Varuna also it is said, "Thou art lord of all, of heaven and earth; thou art king of all those who are gods and of all those who are men." The more spiritual of the Vedic singers, therefore, may be said to have worshipped one God, although not one alone. Some beautiful souls among them were filled not only with the splendours of the visible universe, but with the deeper mysteries of the unseen, and the powerlessness of man to search out God.

> "In the beginning there arose the Golden Child. He was the one born lord of all that is. He established the earth and this sky. Who is the God to whom we shall offer our sacrifice?
>
> "He who gives life, he who gives strength; whose command all the bright gods revere; whose shadow is immortality, whose shadow is death. Who is the God to whom we shall offer our sacrifice?
>
> "He who, through his power, is the one king of the breathing and awakening world. He who governs all, man and beast. Who is the God to whom we shall offer our sacrifice?
>
> "He through whom the sky is bright and the earth firm; he through whom the heaven was established, nay, the highest heaven; he who measured out the light and the air. Who is the God to whom we shall offer our sacrifice?
>
> "He who by his might looked even over the water-clouds; he who alone is God above all gods. Who is the God to whom we shall offer our sacrifice?"

The yearning for rest in God, that desire for the wings of a dove, so as to fly away and be at rest, with which noble hearts have ached in all ages, breathes in several exquisite hymns of the Rig-Veda: "Where there is eternal light, in the world where the sun is placed—in that immortal, imperishable world, place me, O Soma! Where life is free, in the third heaven of heavens, where the worlds are radiant—there make me immortal! Where there are happiness and delight, where joy and pleasure reside, where our desires are attained—there make me immortal."

While the aboriginal races buried their dead under rude stone monuments, the Aryan—alike in India, in Greece, and in Italy—made use of the funeral-pile as the most solemn method of severing the mortal from the immortal part of man. As he derived his natural birth from his parents, and a partial regeneration, or second birth, from the performance of his religious duties; so the fire, by setting free the soul from the body, completed the third or heavenly birth. His friends stood round the pyre as round a natal bed, and commanded his eye to go to the sun, his breath to the wind, his limbs to the earth—the water and plants whence they had been derived. But "as for his unborn part, do thou, Lord (Agni), quicken it; convey it to the world of the righteous."

Several exquisite nymns bid farewell to the dead:—"Depart thou, depart thou by the ancient paths to the place whither our fathers have departed. Meet with the ancient ones; meet with the lord of death. Throwing off thine imperfections, go to thy home. Become united with a body; clothe thyself in a shining form." "Let him depart to those for whom flow the rivers of nectar. Let him depart to those who, through meditation, have obtained the victory; who, by fixing their thoughts on the unseen, have gone to heaven. Let him depart to the mighty in battle, to the heroes who have laid down their lives for others, to those who have bestowed their goods on the poor." The doctrine of transmigration was unknown. The circle round the funeral-pile sang with a firm assurance that their friend went direct to a state of blessedness and reunion with the loved ones who had gone before. "Do thou conduct us to heaven," says a hymn of the later Atharva-Veda; "let us be with our wives and children." "In heaven, where our friends dwell in bliss—having left behind the infirmities of the body, free from lameness, free from crookedness of limb—there let us behold our parents and our children." "May the water-shedding spirits bear thee upwards, cooling thee with their swift motion through the air, and sprinkling thee with dew." "Bear him, carry him; let him, with all his faculties complete, go to the world of the righteous. Crossing the dark valley which spreadeth boundless around him, let the unborn soul ascend to heaven. Wash the feet of him who is stained with sin; let him go upwards with cleansed feet. Crossing the gloom, gazing with wonder in many directions, let the unborn soul go up to heaven."

The hymns of the Rig-Veda were composed, as we have seen, by the Aryans in their colonies along the Indus, and on their march eastwards towards the Jumna and upper Ganges. The growing numbers of the settlers, and the arrival of fresh Aryan tribes from behind, still compelled them to advance. From the land of the sacred singers, Manu describes them as spreading through "The Middle Land" (*Madhyadesha*), comprising the whole river-systems of Upper India as far east as Oudh and Allahabad, with the Himalayas as its northern and the Vindhya ranges as its southern boundary. The conquest of the vast new tracts thus included seems not to have commenced till the close of the Rig-Vedic era, and it must have been the work of many generations. During this advance the simple faith of the Rig-Vedic singers was first adorned with stately rites, and then extinguished beneath them. The race progressed from a loose confederacy of tribes into several well-knit nations, each bound together by the strong central force of kingly power, directed by a powerful priesthood and organized on a firm basis of caste.

Whence arose this new constitution of the Aryan tribes into nations, with castes, priests, and kings? We have seen that although in their earlier colonies on the Indus each father was priest in his family, yet the chieftain, or lord of the settlers, called in some man specially learned in holy offerings to conduct the great tribal sacrifices. Such men were highly honoured, and the famous quarrel which runs throughout the whole Veda sprang from the claims of two rival sages, Vasishtha and Viswamitra, to perform one of these ceremonies. The art of writing was unknown, and the hymns and sacrificial words had to be handed down by word of mouth from father to son. It thus happened that the families who learned them by heart became, as it were, the hereditary owners of the liturgies required at the most solemn offerings to the gods. Members of these households were chosen again and again to conduct the tribal sacrifices, to chant the battle hymn, to implore the divine aid, or to pray away the divine wrath. Even the Rig-Veda recognizes the importance of these sacrifices. "That king," says a verse, "before whom marches the priest, he alone dwells well established in his own house, to him the people bow down. The king who gives wealth to the priest, he will conquer, him the gods will protect." The tribesmen first hoped, then believed, that a hymn or prayer which had once acted successfully, and been followed by victory, would again produce the same results. The hymns became a valuable family property for those who had composed or learned them. The Rig-Veda tells how the prayer of Vasishtha prevailed "in the battle of the ten kings," and how that of Viswamitra "preserves the tribe of the Bharats." The potent prayer was termed *brahma*, and he who offered it *brahman*. Woe to him who despised either! "Whosoever," says the Rig-Veda, "scoffs at the prayer (*brahma*) which we have made, may hot plagues come upon him, may the sky burn up that hater of Brahmans" (*brahma-drish*).

Certain families thus came to have not only a hereditary claim to conduct the great sacrifices, but also the exclusive knowledge of the ancient hymns, or at any rate of the traditions which explained their symbolical meaning. They naturally tried to render the ceremonies solemn and imposing. By degrees a vast array of ministrants grew up around each of the greater sacrifices. There were first the officiating priests and their assistants, who prepared the sacrificial ground, dressed the altar, slew the victims, and poured out the libations; second, the chanters of the Vedic hymns; third, the reciters of other parts of the service; fourth, the superior priests, who watched over the whole, and corrected mistakes.

The Sutras.—The priests composed a number of new works, called Sutras, which elaborated still further their system of sacrifice, and which asserted still more strongly their own claims as a separate and superior caste. They alleged that these Sutras, although not directly revealed by God, were founded on the inspired Vedas and Brahmanas, and that they had therefore a divine authority as sacred traditions (*smriti*). The Sutras were composed in the form of, literally, strings of aphorisms or short sentences, for the sake of brevity, and in order that their vast number might be the better remembered in an age when writing was little practised or unknown. Some of them, such as the Kalpa-Sutras, deal with the ritual and sacrifices; others, like the Household or Grihya-Sutras, with the ceremonies at birth, marriage, and death; a still larger class of Sutras with the doctrines, duties, and privileges of the priests. They thus became the foundation of the whole legislation and philosophy of the Brahmans in later times. [See BRAHMANISM.] The Sutras exhibit the Brahmans no longer as the individual sacrificers of the Vedic period, but as a powerful hereditary caste, claiming supremacy alike over the kings and the people.

Meanwhile other castes had been gradually formed. As the Aryans moved eastwards from the Indus, some of the warriors were more fortunate than others, or received larger shares of the conquered lands. Such families had not to till their fields with their own hands, but could leave that work to be done by the aboriginal races whom they subdued. In this way there grew up a class of warriors, freed from the labour of husbandry, who surrounded the chief or king, and were always ready for battle. It seems likely that these kinsmen and companions of the king formed an important class among the early Aryan tribes in India, as they certainly did among the ancient branches of the race in Europe, and still do at the petty courts of India. In process of time, when the Aryans settled down, not as mere fighting clans, but as powerful nations, in the Middle Land along the Jumna and the Ganges, this warrior class grew in numbers and in power. The black races had been reduced to serfdom, or driven back towards the Himalayas and the Vindhyas, on the north and the south of the central tract. The incessant fighting, which had formed the common lot of the tribes on their actual migration eastwards from the Indus, ceased. A section of the people laid aside

their arms, and devoted themselves to agriculture or other peaceful pursuits. The sultry heats of the Middle Land must also have abated their old northern energy, and led them to love repose. Those who, from family ties or from personal inclination, preferred a soldier's life, had to go beyond the frontier to find an enemy. Distant expeditions of this sort could be undertaken much less conveniently by the husbandman than in the ancient time, when his fields lay on the very border of the enemy's country, and had just been wrested from it. Such expeditions required and probably developed a class of soldiers whose presence was not constantly needed at home for tilling the land. The old warrior companions and kinsmen of the king formed a nucleus round which gathered the more daring spirits, and laid the foundation of a military caste.

The Aryans on the Ganges, in the Middle Land, thus found themselves divided into three classes—first, the priests or Brahmans; second, the warriors and king's companions, called in ancient times Kshattriyas, at the present day Rajputs; third, the husbandmen or agricultural settlers, who retained the old name of Vaisyas (from the root *vis*), which in the Vedic period had included the whole people. These three classes gradually became distinct castes; intermarriage between them ceased, and each kept more and more strictly to its hereditary employment. But they were all recognized as belonging to the Twice-born or Aryan race; they were all present at the great national sacrifices, and all worshipped the same bright gods. Beneath them was a fourth or servile class, called Sudras, the remnants of the vanquished aboriginal tribes whose lives had been spared. These were the slave-bands of black descent, the Dasas of the Veda. They were distinguished from their Twice-born Aryan conquerors as being only Once-born, and by many contemptuous epithets. They were not allowed to be present at the great national sacrifices, or at the feasts which followed them. They could never rise out of their servile condition; and to them was assigned the severest toil in the fields and all the hard and dirty work of the village community. See CASTE.

The paramount position which the Brahmans won resulted, in no small measure, from the benefits which they bestowed. For their own Aryan countrymen they developed a noble language and literature. The Brahmans were not only the priests and philosophers, but also the lawgivers, the administrators, the men of science, and the poets of their race. Their influence on the aboriginal peoples, the hill and forest races of India, was even more important. To these rude remnants of the flint and bronze ages they brought in ancient times a knowledge of the metals and the gods. Within the historical period the Brahmans have incorporated the mass of the backward races into the social and religious organization of Hinduism. A system of worship is a great comfort to a tropical people hemmed in by the uncontrolled forces of nature, as it teaches them how to propitiate those mysterious powers, and so tends to liberate their minds from the terrors of the unseen. The reflective life of the Middle Land (*Madhya-desha*) led the Brahmans to see that the old gods of the Vedic hymns were in reality not supreme beings, but poetic fictions; for when they came to think the matter out they found that the sun, the aqueous vapour, the encompassing sky, the wind, and the dawn, could not each be separate and supreme creators, but must have all proceeded from one first cause. They did not shock the religious sense of the less speculative castes by any public rejection of the Vedic deities. They accepted the old Shining Ones of the Veda as beautiful manifestations of the divine power, and continued to decorously conduct the sacrifices in their honour. But among their own caste the Brahmans distinctly enunciated the unity of God. To the Veda, the Brahmanas, and the Sutras, they added a vast body of theological literature, composed at intervals between 800 B.C. and 1000 A.D. The Upanishads, meaning, according to their great Brahman expounder, "The Science of God," and his "identity with the soul;" the Aranyakas, or "Tracts for the Forest Recluse;" and the much later Puranas, or "Traditions from of Old," contain mystic and beautiful doctrines regarding the unity of God and the immortality of the soul, mingled with less noble dogmas, popular tales, and superstitions. The mass of the people were left to believe in four castes, four Vedas, and many deities; but the higher thinkers among the Brahmans recognized that in the beginning there was but one caste, one Veda, and one God.

The old Shining Ones of the Vedic singers were, indeed, no longer suitable deities, either for the life which the Aryans led after they advanced into Southern Bengal, or for the country in which they lived. The Vedic gods were the good friends of the free-hearted warring tribes in Northern India, settled on the banks of fordable streams or of not overpowering rivers. In Central and South-eastern Bengal the Brahmans required deities whose nature and attributes would satisfy profoundly reflective minds, and at the same time would be commensurate with the stupendous forces of nature amid which they dwelt. The storm gods (Maruts) of the Veda might suffice to raise the dust-whirlwinds of the Punjab, but they were evidently deities on a smaller scale than those which wielded the irresistible cyclones of Bengal. The rivers, too, had ceased to be merely bountiful givers of wealth, as in the north. Their accumulated waters came down in floods, which buried cities and drowned provinces, wrenching away the villages on their banks, destroying and reproducing the land with an equal balance. The high-born dawn, the genial sun, and the friendly day, with the other kind but confused old groups of Vedic deities, gave place to the conception of one god in his three solemn manifestations as Brahma the creator, Vishnu the preserver, and Siva the destroyer and reproducer. Each of these had his prototype among the Vedic deities, and they remain to this hour the three persons of the Hindu triad. Brahma, the creator, was too abstract in idea to be a popular god; and in journeying through India travellers report finding only one great seat of his worship at the present day, on the margin of the sacred lake Pushkara, near Ajmere. One day of Brahma is 2160 millions of man's years. Vishnu, the preserver, was a more useful and practical deity. In his ten incarnations, especially in his seventh and eighth, as Rama and Krishna, under many names and in widely varying forms, he took the place of the old bright Vedic gods. Siva, the third person of the triad, embodied as destroyer and reproducer the profound conception of death as a change of state and an entry into new life. He thus obtained, on the one hand, the special reverence of the mystic and philosophic sects among the Brahmans; while, on the other, his terrible aspects associated him alike with the Rudra, or god of roaring tempests, of the Veda, and with the blood-loving deities of the non-Aryan tribes. Vishnu and Siva, in their diverse male and female shapes, now form, for practical purposes, the gods of the Hindu population.

The truth is, that the Aryans in India worshipped, first, as they felt; then, as they admired; and finally, as they reasoned. Their earliest Vedic gods were the stupendous phenomena of the visible world; their deities became divine heroes in the epic legends, and were spiritualized into abstractions by the philosophical schools. From the Vedic era downward, that is to say, during a period which cannot be estimated at less than 3000 years, the Brahmans have slowly elaborated the forces and splendid manifestations of nature into a harmonious godhead, and constructed a system of belief and worship for the Indian people. They also pondered deeply on the mysteries of life. Whence

arose this fabric of the visible world? and whence came we ourselves, we who with conscious minds look out upon it? It is to these questions that philosophy has, among all races, owed her birth; and the Brahmans arranged their widely diverse answers to them in six great systems or *darsanas*, literally mirrors of knowledge. Thus a vast body of speculation grew up at least 500 years before Christ. The universal insoluble problems of thought and being, of mind and matter, and of soul as apart from both; of the origin of evil, of the *summum bonum* of life, of necessity and freewill, and of the relations of the Creator to the creature, are endlessly discussed. All the six schools had the same starting-point, *ex nihilo nihil fit;* and their sages, as a rule, struggled towards the same end, the liberation of the human soul from the necessity of existence and from the chain of future births, by its absorption into the supreme soul or the primordial essence of the universe.

Language.—The science of language had been reduced in India to fundamental principles at a time when the grammarians of the West still treated it on the basis of accidental resemblances, and modern philology itself dates from the study of Sanskrit by European scholars. Panini was the architect of Sanskrit grammar; but a long succession of learned men must have laboured before he reared his enduring fabric. The date of Panini has been fixed by his learned editor Böhtlingk at about 350 B.C.; but Weber, reasoning from a statement made long afterwards by the Chinese pilgrim Hiouen Thsang, suggests that it may have been later. The grammar of Panini stands supreme among the grammars of the world, alike for its precision of statement and for its thorough analysis of the roots of the language and of the formative principles of words. By employing an algebraic terminology it attains a sharp succinctness unrivalled in brevity, but at times enigmatical. It arranges in logical harmony the whole phenomena which the Sanskrit language presents, and stands forth as one of the most splendid achievements of human invention and industry. So elaborate is the structure that doubts have arisen whether its innumerable rules of formation and phonetic change, its polysyllabic derivatives, its ten conjugations with their multiform aorists and long array of tenses, could ever have been the spoken language of a people. It is certain that at an early date Sanskrit began to undergo simplification; and that the Aryan peasant, alike in his ancient and modern vernaculars, contented himself with narrower forms of speech.

It seems probable, indeed, that this divergence took place before the time of Panini (350 B.C.), and that the spoken language, or *Prakrita-bhasha*, had already assumed simpler forms by the assimilation of consonants and the curtailment of terminals. The *Sanskrita-bhasha*, literally the "perfected speech," which Panini stereotyped by his grammar, retained the old Aryan accumulations of consonants, with an undiminished array of inflections. In this language the Brahmans wrote. It became the literary language of India—isolated from the spoken dialects, but prescribed as the vehicle for philosophy, science, and all poetry of serious aim or epic dignity. As the Aryan race mingled with the previous inhabitants of the land, the Indian vernaculars adopted words of non-Aryan origin, and severed themselves completely from Sanskrit, which for many hundred years has been unintelligible to the common people of India. The old synthetic Sanskrit underwent the same process as Latin, into an analytic language, and about the same time. Each of these noble languages died, and each gave birth to a family of languages which can never die. An intermediate stage of the process can be traced in the Hindu drama, in which persons of good birth speak in Prakritized Sanskrit, and the low castes in a *bhasha*, or patois, between the old Prakrit and the modern dialects. It is chiefly under the popularizing influences of British rule that the Indian vernaculars have become literary languages. Until the last century Sanskrit, although as dead as Latin so far as the mass of the people were concerned, was the vehicle for all intellectual and artistic efforts of the Hindus, their local ballads excepted. In addition to their other sources of influence, therefore, the Brahmans were the interpreters of a national literature written in a language unknown to the people.

The priceless inheritance thus committed to their charge they handed down, to a great extent, by word of mouth. Partly from this cause, but chiefly owing to the destructive climate of India, no Sanskrit manuscripts of remote antiquity exist. A fairly continuous series of inscriptions on rocks, pillars, and copper-plates enable us to trace back the Indian alphabets to the third century B.C. But even the more ancient of the Sanskrit manuscripts are only four hundred years old, very few have an age exceeding five centuries, and only two date as far back as 1132 and 1008 A.D. The earliest of them (1008 A.D.) comes from the cold, dry highlands of Nepal. With regard to the origin of the Indian alphabets, the evidence is still too undigested to allow of cursory statement. Of the two characters in which the Asoka inscriptions were written (250 A.D.), the northern variety, or Ariano-Pali, is now admitted to be of Phœnician, or at any rate of non-Indian, parentage. The southern variety, or Indo-Pali, is believed by some scholars to be of western origin, while others hold it to be an independent Indian alphabet; and an attempt has even been made to trace back its letters to an indigenous system of picture-writing or hieroglyphics in prehistoric India. Quintus Curtius mentions that the Indians wrote on leaves in the time of Alexander (326 B.C.) They do so to this hour.

Sanskrit literature was the more easily transmitted by word of mouth, from the circumstance that it was entirely written in verse. A prose style, simple and compact, had grown up during the early age following that of the Vedic hymns. But Sanskrit literature begins with the later, although still ancient, stage of Aryan development, which had superseded the Vedic gods by the Brahmanical triad, Brahma, Vishnu, and Siva. When Sanskrit appears definitively on the scene in the centuries preceding the birth of Christ, it adopted once and for all a rhythmic versification alike for poetry, philosophy, science, law, and religion, with the exception of the beast fables and the almost algebraic strings of aphorisms in the Sutras. The Buddhist legends adhered more closely to the spoken dialects of ancient India, *Prakrita-bhasha;* and they have also retained a prose style. But in classical Sanskrit literature, prose became an arrested development: the *sloka* or verse reigned supreme; and nothing can be clumsier than the attempts at prose in the later romances and commentaries. Prose-writing was practically a lost art in India for eighteen hundred years.

Sanskrit dictionaries are a much later product than Sanskrit grammar. The oldest Indian lexicographer whose work survives, Amara-sinha, ranked among the "nine gems" at the court of Vikramaditya—one of several monarchs of the same name, assigned to various periods from 56 B.C. to 1050 A.D. This dictionary furnishes data which certainly belong to a later period than the first century B.C.; probably to many hundred years later. The other Sanskrit lexicons which have come down belong to the eleventh, twelfth, and subsequent centuries. Those centuries, indeed, seem to mark an era of industry in dictionary-making; and there is no inherent evidence in Amara-sinha's work (the Amara-kosha) to show that it was separated from them by any wide interval.

As previously stated the same natural process under which Romance languages were formed from Latin operated to produce the North Indian vernaculars from the Sanskrit, which bears much the same relation to them that Latin

does to the languages of Spain, Portugal, Italy, and France. One of the dialects was Hindi; this, overlaid with Arabic and Persian words, after the Afghan conquest, was changed into Hindustani, and so of the others. Or Hindustani may be distinguished into Urdu, which borrows from Arabic and Persian, and Hindi, which borrows from the Sanskrit. The chief languages of the class are the Bengali or Gaura proper, Hindi and its offspring Hindustani, Punjabi, Sindhi, Gujerati, Marhatti and its offspring Concani, Oriya, Marwari, Assamese, Cashmeri, and the court language of Nepaul. Hindustani is the distinctive tongue of the Mohammedans of the Deccan, Oriya is spoken in Orissa; Marhatti is also spoken in parts of the Deccan; the names of the others sufficiently indicate the districts where they prevail. In all of these tongues there is a considerable Scythic substratum, due to the influence of the aboriginal people. The Sanskrit character is used in the Hindi and Marhatti; the others have a distinct character. The Dravidian languages are so called from the Sanskrit name for Tamil, the Dravidas being a people of the south. Among the Scythian or Turanian group of tongues the one to which they are most closely related is the Ugrian or Finnish, and the more special affinities are with the Ostiak, a remarkable circumstance as indicating a very early migration from the dreary Siberian regions into the sunny plains of India. The Dravidian group contains six cultivated and six uncultivated dialects; the cultivated are the Tamil, Telugu, Malayalam, Canarese, Tulu, Coorg or Kudagu. The Tamil, the earliest cultivated and the most copious, is spoken by 15,000,000 people in South-eastern India, and in the north and north-west parts of Ceylon. It is found in all the marts of the East, the Tamils being the most energetic and enterprising of the Hindus. Telugu ranks next in antiquity of culture and in copiousness, but has more sweetness; it is spoken by 16,000,000 people on the east side of the Bay of Bengal, north of Pulicat, south of Orissa, and inland as far as the boundary of Mysore, and in part of the Nizam's territory. The Malayalam, the Malabar of the Portuguese, is spoken by nearly 4,000,000 people on the south-west coast; Canarese by 10,000,000 in the Mysore and part of the Nizam's dominion; Tulu by 300,000 persons in a small district of Canara; in its limited literature the Canarese character is used. The Coorg is spoken by 150.000 persons in the district of this name. The Telugu and Canarese characters are the same; the others have a distinct character. The other six languages are entirely uncultivated and have no written character; they are Gund, Khund or Ku, Oraon, Rajmahal, Kota, and Tuda. A few other non-Aryan languages, which seem to have originated in mixtures of the Indo-Chinese or Tibetan tongues with Indian dialects, are spoken by tribes in the mountain forests of the sub-Himalayas, and there is a great variety of local dialects. The Parsees of the west speak the Gujerati.

Indian Art.—Both in form and colour, and more than in either of these, in its exquisite workmanship, Indian art holds a high place. INDIAN ARCHITECTURE is separately treated of. English decorative art in our day has borrowed largely from Indian forms and patterns. The exquisite scrolls of the rock-temples at Karli and Ajunta, the delicate marble tracery and flat wood-carving of Western India, the harmonious blending of forms and colours in the fabrics of Cashmere, have contributed to the restoration of taste in England. Indian art-work, when faithful to native designs, has obtained the highest honours at the various international exhibitions of Europe. In pictorial art the Hindus never made much progress, except in miniature-painting, for which perspective is not required. But some of the book-illustrations, executed in India under Persian impulses, are full of spirit and beauty. The royal library at Windsor contains the finest existing examples in this by-path of art, a noble manuscript of the Shah Jahan Namah, purchased in Oudh for £1200 in the last century, and now in possession of her Majesty, will amply repay a visit. The specimens at the South Kensington Museum do not adequately represent that branch of Indian painting. But they are almost everything that could be desired as regards Indian design, even including Persian bookbinding and several of the minor formative arts.

Law.—As the Brahmans spread their influence eastwards and southwards from the middle land of Bengal, they carried their codes with them, and as they gradually moulded the population of India into Hinduism, such codes proved too narrow a basis for dealing with the rights, duties, and social organization of the people. The later Hindu legislators accordingly inculcated the recognition of the local usages or land-law of each part of the country, and of each class or tribe. While binding together and preserving the historical unity of the Aryan twice-born castes by systems of law founded on their ancient codes, they made provision for the customs and diverse stages of civilization of the ruder peoples of India, over whom they established their ascendency. By such provisions, alike in religion and law, the Brahmans incorporated the Indian races into that loosely coherent mass known as the Hindu population. The English on assuming the government of India wisely declared that they would administer justice according to the customs of the people. But our high courts enforce the Brahmanical codes with a comprehensiveness and precision unknown in ancient India. Each age has the gift of adjusting its institutions to its actual wants, especially among tribes whose customs have not been reduced to written law. Many of those customs will, if left to themselves, die out; others of them, which prove suited to the new social developments under British rule, will live.

Secular Literature of the Hindus.—The Brahmans were not merely the depositaries of the sacred books, the philosophy, the science, and the laws of the ancient Hindu commonwealth; they were also the creators and custodians of its secular literature. They had a practical monopoly of Vedic learning, and their policy was to trace back every branch of knowledge and of intellectual effort to the Veda. In this policy they were aided by the divergence which arose at a very early date between the written and spoken languages of India. Sanskrit literature, apart from religion, philosophy, and law, consists mainly of two great epics, the drama, and a vast body of legendary, erotic, and mystical poetry.

The venerable epic of the Mahabharata ranks first. The orthodox legend ascribes it to the sage Vyasa, who, according to Brahman chronology, compiled the inspired hymns into the four Vedas, nearly 5000 years ago (3001 B.C.) But one beauty of Sanskrit is that every word discloses its ancient origin in spite of mediæval fictions, and Vyasa means simply the arranger, from the verb "to fit together." No fewer than twenty-eight Vyasas, incarnations of Brahma and Vishnu, came down in successive astronomical eras to arrange and promulgate the Vedas on earth. Many of the legends in the Mahabharata are of Vedic antiquity, and the main story deals with a period assigned, in the absence of any conclusive evidence, to about 1200 B.C., and certainly long anterior to the time of Buddha, 543 B.C. But its compilation into its present literary form seems to have taken place several centuries later. Panini makes no clear allusion to it (350 B.C.) The inquisitive Greek ambassador and historian, Megasthenes, does not appear to have heard of it during his stay in India, 300 B.C. Dion Chrysostomos supplies the earliest external evidence of the existence of the Mahabharata, about 75 A.D. The arrangement of its vast mass of legends must probably have covered a long period.

Indeed, the present poem bears traces of three separate eras of compilation, during which its collection of primitive folk-tales grew (as stated by itself) from 8800 *slokas* or couplets into a cyclopædia of Indian mythology and legendary lore extending over eighteen books and 220,000 lines. The twenty-four books of Homer's Iliad comprise only 15,693 lines, and the twelve books of Virgil's Æneid only 9868.

The central story of the Mahabharata occupies scarcely one-fourth of the whole, or about 50,000 lines. It narrates a prehistoric struggle between two families of the Lunar race for a patch of country near Delhi. These families, alike descended from the royal Bharata, consisted of two brotherhoods, cousins to each other, and both brought up under the same roof. The five Pandavas were the miraculously born sons of King Pandu, who, smitten by a curse, resigned the sovereignty to his brother Dhrita-rashtra, and retired to a hermitage in the Himalayas, where he died. The ruins of his capital, Hastinapura, or the Elephant City, are pointed out beside a deserted bed of the Ganges, 57 miles north-east of Delhi, at this day. His brother ruled in his stead, and to him 100 sons were born, who took the name of the Kauravas, from an ancestor, Kuru. Dhrita-rashtra acted as a faithful guardian to his five nephews, the Pandavas, and chose the eldest of them as heir to the family kingdom. His own sons resented this act of supercession, and so arose the quarrel between the 100 Kauravas and the five Pandavas, which forms the main story of the Mahabharata.

The second great Indian epic, the Ramayana, recounts the advance of the Aryans into Southern India. Unlike the Mahabharata, its composition is assigned not to a compiler (*vyasa*) in the abstract, but to a named poet, Valmiki. On the other hand, the personages and episodes of the Ramayana have an abstract or mythological character, which contrasts with the matter-of-fact stories of the Mahabharata.

Drama and Fable.—In India, as in Greece and Rome, scenic representations seem to have taken their rise in the rude pantomime of a very early time, possibly as far back as the Vedic ritual; and the Sanskrit word for the drama, *nataka*, is derived from *nata*, a dancer. But the Sanskrit dramas of the classical age which have come down to us probably belong to the period between the first century B.C. and the eighth century A.D. They make mention of Greek slaves, are acquainted with Buddhism in its full development, and disclose a wide divergence between Sanskrit and the dialects used by the lower classes. The Mahabharata and Ramayana appear in the drama as part of the popular literature—in fact, as occupying very much the same position which they still hold. No dramas are yet known to exist among the works which the Hindus who emigrated to Java about 500 A.D. carried with them to their homes, nor among the Tibetan translations of the Sanskrit classics.

The most famous drama of Kalidasa is "Sakuntala, or the Lost Ring." Like the ancient epics, it divides its action between the court of the king and the hermitage in the forest. Prince Dushyanta, an ancestor of the nobl Lunar race, weds by an irregular marriage a beautiful Brahman girl, Sakuntala, at her father's retreat in the jungle. Before returning to his capital he gives his bride a ring as a pledge of his love; but smitten by a curse from a Brahman, she loses the ring, and cannot be recognized by her husband till it is found. Sakuntala bears a son in her loneliness, and sets out to claim recognition fo herself and child at her husband's court. But she is as one unknown to the prince, till, after many sorrows and trials, the ring comes to light. She is then happily reunited with her husband, and her son grows up to be the noble Bharata, the chief founder of the Lunar dynasty, whose achievements form the theme of the Mahabharata. Sakuntala, like Sita, is the type of the chaste and faithful Hindu wife; and her love and sorrow, after forming the favourite romance of the Indian people for perhaps 1800 years, have furnished a theme for the great European poet of our age. "Wouldst thou," says Goethe—

> "Wouldst thou the young year's blossoms, and the fruits of its decline,
> And all by which the soul is charmed, enraptured, feasted, fed—
> Wouldst thou the earth and heaven itself in one sole name combine?
> I name thee, O Sakuntala! and all at once is said."

Sakuntala has had the good fortune to be translated by Sir William Jones (1789), and to be sung by Goethe. But other of the Hindu dramas and domestic poems are of almost equal interest and beauty. The drama was one of the first branches of Hindu literature to heartily accept the spoken dialects; and the native theatre forms the best, indeed the only, school in which an Englishman can acquaint himself with the indoor life of the people. In our own day there has been a great dramatic revival in India; new plays in the vernacular tongues constantly issue from the press; and societies of patriotic young natives form themselves into dramatic companies, especially in Calcutta and Bombay. Many of the pieces are vernacular renderings of stories from the Sanskrit epics and classical dramas. Several have a political significance, and deal with the phases of development upon which India has entered under the influence of British rule.

Closely allied to the drama is the prose romance. Dr. H. Wilson said that Hindu literature contained collections of domestic narrative to an extent surpassing that of any other people. The fables of animals familiar to the western world, from the time of Æsop downwards, had their original home in India. The relation between the fox and the lion in the Greek versions has no reality in nature; but it was based upon the actual relation between the lion and his follower the jackal in the Sanskrit stories. Weber thinks that complete cycles of Indian fables may have existed in the time of Panini (350 B.C.?) It is known that the Sanskrit "Panchatantra, or Book of Beast Tales," was translated into the ancient Persian as early as the sixth century A.D., and from that rendering all the subsequent versions in Asia Minor and Europe have been derived. The most ancient animal fables of India are at the present day the nursery stories of England and America. The graceful Hindu imagination delighted also in fairy tales; and the Sanskrit compositions of this class are the original source of many of the fairy stories of Persia, Arabia, and Christendom.

In mediæval India a large body of poetry, half-religious, half-amorous, grew up around the legend of the youthful Krishna (the eighth incarnation of Vishnu) and his loves with the shepherdesses, the playmates of his sweet pastoral life. Kalidasa, according to Hindu tradition, was the father of the erotic lyric, as well as a great dramatic and epic poet. In his "Megha-duta, or Cloud Messenger," an exile sends a message by a wind-borne cloud to his love, and the countries beneath its long aerial route are made to pass like a panorama before the reader's eye. The "Gita Govinda, or Divine Herdsman of Jayadeva" is a Sanskrit Song of Solomon, not earlier than the twelfth century A.D. A festival once a year celebrates the birthplace of this mystical love-poet in the Birbhum District of Lower Bengal; and many less famous compositions of the same class now issue from the vernacular press throughout India.

The mediæval Brahmans displayed a marvellous activity in theological as well as in lyric poetry. The Puranas, literally "The Ancient Writings," form a collection of religious and philosophical treatises in verse, of which the principal ones number eighteen. The whole Puranas

are said to contain 1,600,000 lines. The really old ones have either been lost or been incorporated in new compilations; and the composition of the existing Puranas probably took place from the eighth to the sixteenth century A.D. As the epics sang the wars of the Aryan heroes, so the Puranas recount the deeds of the Brahman gods. They deal with the creation of the universe; its successive dissolutions and reconstructions; the stories of the deities and their incarnations; the reigns of the divine Manus; and the chronicles of the Solar and Lunar lines of kings who ruled, the former in the east and the latter in the west of the Middle Land (Madhya-desha). The Puranas belong to the period when the Hindus had split up into their two existing divisions, as worshippers of Vishnu or of Siva. They devote themselves to the glorification of one or other of these two rival gods, and thus embody the sectarian theology of Brahmanism. While claiming to be founded on Vedic inspiration, they practically superseded the Veda, and have formed during ten centuries the sacred literature on which Hinduism rests.

In order to understand the long domination of the Brahmans and the influence which they still wield, it is necessary ever to keep in mind their position as the great literary caste. Their priestly supremacy has been repeatedly assailed, and was during a space of nearly 1000 years overthrown. But throughout twenty-two centuries they have been the counsellors of Hindu princes and the teachers of the Hindu people. They represent the early Aryan civilization of India; and the essential history of the Hindus is a narrative of the attacks upon the continuity of that civilization—that is to say, of attacks upon the Brahmanical system of the Middle Land, and of the modifications and compromises to which that system has had to submit. Those attacks range themselves under six epochs. First, the religious uprising of the half-Brahmanized Aryan tribes on the east of the Middle Land, initiated by the preaching of Buddha in the sixth century B.C., culminating in the Buddhist kingdoms about the commencement of our era [see BUDDHISM], and melting into modern Hinduism about the eighth century A.D. Second, warlike inroads of non-Brahmanical Aryans or other races from the west, commencing with the Greek invasions in the fourth century B.C., and continuing under the Greco-Bactrian empire and its successors to probably the third or fifth century A.D. Third, the influence of the non-Aryan tribes of India and of the non-Aryan low castes incorporated from them; an influence ever at work—indeed by far the most powerful agent in dissolving Brahmanism into Hinduism, but represented in a special manner by the non-Aryan kingdoms about the seventh and eighth centuries A.D. Fourth, the reaction against the low beliefs, priestly oppression, and bloody rites which resulted from this compromise between Brahmanism and aboriginal worship. The reaction received an impetus from the preaching of Sankar Acharja, who founded the great Sivaite sect about 700 A.D. It obtained its full development under a line of great Vishnuvite reformers from the twelfth to the sixteenth centuries A.D. Fifth, Mohammedan invasions and the rule of Islam, 1000 to 1765 A.D. Sixth, the English supremacy, and the popular upheaval which it has produced in the eighteenth and nineteenth centuries.

Hinduism.—Brahmanism and Buddhism have already been described in separate articles. Buddhism never ousted Brahmanism from any large part of India. The two systems co-existed as popular religions during more than 1000 years (244 B.C. to about 800 A.D.), and modern Hinduism is the joint product of both. This may be described as a social organization and a religious confederacy. As a social organization it rests upon caste, with its roots deep down in the ethnical elements of the Indian people. As a religious confederacy it represents the coalition of the old Vedic faith of the Brahmans with Buddhism on the one hand, and with the ruder rites of the pre-Aryan and Indo-Scythic races on the other.

The ethnical basis of caste is disclosed in the old division of the people into the "twice-born" Aryan castes, including Brahmans, Kshattriyas, and Vaisyas; and the "once-born" non-Aryan Sudras. The twice-born castes still wear the sacred thread, and claim a joint, although an unequal, inheritance in the holy books of the Veda. The once-born castes are still denied the sacred thread, and their initiation into the religious literature of the Indo-Aryans has only been effected by the secular teaching of our Anglo-Indian schools. But while caste is thus deeply founded in the distinctions of race, its superstructure has been regulated by another system of division, based on the occupations of the people. The early classification of the people may be expressed either ethnically as twice-born Aryans and once-born non-Aryans, or socially, as priests, warriors, husbandmen, and serfs. On the two principles of classification, according to race and according to employment, still further modified by geographical position, has been built up the ethnical and social organization of Indian caste. [See CASTE.] As a rule it may be said that the Aryan or twice-born castes adhere most closely to the ethnical principle of division; the once-born or distinctly non-Aryan to the same principle, but profoundly modified by the concurrent principle of employment, while the mixed progeny of the two are almost entirely classified in modern times according to their occupation. But such generalizations must be taken as subject to many exceptions; and at every point distinctions according to locality make themselves felt.

In many parts of India Brahmans may be found earning their livelihood as porters, shepherds, cultivators, potters, and fishermen, side by side with others who would rather starve and see their wives and little ones die of hunger, than demean themselves to manual labour or let food prepared by a man of inferior caste pass their lips.

The Hindu custom now forbids marriage between (1) persons of the same *gotra* or kindred, and (2) persons of different castes. But this precise double rule has been arrived at only after many intermediate experiments in endogamous and exogamous tribal life. Such survivals constitute an important branch of law, in fact, the common law of India, and furnish one of the chief difficulties in the way of Anglo-Indian codification.

Hinduism is, however, not only a social organization resting upon caste; it is also a religious federation based upon worship. As the various race-elements of the Indian people have been welded into caste, so the simple old beliefs of the Veda, the mild doctrines of Buddha, and the fierce rites of the non-Aryan tribes have been thrown into the melting-pot, and poured out thence as a mixture of alloy and dross to be worked up into the Hindu gods. Buddhism not only breathed into the new birth its noble spirit of charity, but bequeathed to Hinduism many of its institutions unimpaired, together with its scheme of religious life and the material fabric of its worship. At this day the *mahajan* or bankers' guild, in Surat, devotes part of the fees that it levies on bills of exchange to animal hospitals—true survivals of an edict which provided a system of medical aid for beasts 250 years before Christ!

The religious houses of the Orissa delta, with their revenue of £50,000 a year, are but the Hindu developments of the Buddhist cells and rock monasteries, whose remains still honeycomb the adjacent hills. In the religious life of the Vishnuvite communities their rules are Buddhistic, with Brahmanical reasons attached. Thus the moral code of the Kabir Panthis consists of five rules:—First, life, whether of man or beast, must not be violated; because it is the gift of God. Second, humanity is the cardinal virtue; and the shedding of blood, whether of man or beast, a heinous crime. Third, truth is the great

principle of conduct; because all the ills of life and ignorance of God are due to original falsehood (*maya*). Fourth, retirement from the world is desirable; because the desires of the world are hostile to tranquillity of soul, and to the undisturbed meditation on God. Fifth, obedience to the spiritual guide is incumbent on all. This last rule is common to every sect of the Hindus. But the Kabir Panthis direct the pupil to examine well his teacher's life and doctrine before he resigns himself to his control. If we did not know that Buddhism was itself an outgrowth from primitive Brahmanism, we might hold this code to be simple Buddhism, with the addition of a personal God. But knowing that Brahmanism and Buddhism were themselves closely connected, and that they combined to form Hinduism, it is impossible to discriminate exactly how far the last was made up by direct transmission from either of the other two.

Hinduism, however, derived its elements not merely from the two ancient Aryan faiths, the Brahmanical and the Buddhist. In its popular aspects it drew much of its strength and many of its rites from the Naga and other non-Aryan peoples of India. Buddhists and Brahmans alike endeavoured, during their long struggle, to enlist the masses on their side. The Naga kingdoms were divided by the Chinese geographers into those which had accepted Buddhism and those which had not. A chief feature in Naga-worship was the reverence for dragons or tailed monsters. This reverence found its way into mediæval Buddhism, and became an important element in Buddhist mythology. Indeed, Fergusson in his "Tree and Serpent Worship" goes so far as to say that "Buddhism was little more than a revival of the coarser superstitions of the aboriginal races, purified and refined by the application of Aryan morality." Buddhism from the first had to contend as much against the under current of Naga reverence in the popular mind, as against the supercilious opposition of the philosophic Brahman in the upper current. At last, as it would seem, driven to an extremity by the gathering cloud of persecution, the Buddhists sought escape by closing with the popular creed, and endeavouring to enlist the people against the priests; but with no further success than such a respite as might be included within some one hundred years.

This conception of the process is coloured by modern ideas, but there can be no doubt that Hinduism incorporated many aboriginal rites. It had to provide for the non-Aryan as well as for the Aryan elements of the population, and it combined the Brahmanism and Buddhism of the Aryans with the fetish-worship and religion of terror which swayed the non-Aryan races. Some of its superstitions seem to have been brought by Turanian or Scythian migrations from Central Asia. The fetish and tree worship of the non-Aryan races also entered largely into Hinduism. The first Englishman who tried to study the natives as they actually are, and not as the Brahmans described them, was struck by the universal prevalence of a worship quite distinct from that of the Hindu deities. A Bengal village has usually its local god, which it adores either in the form of a rude unhewn stone, or a stump, or a tree marked with red lead. Sometimes a lump of clay placed under a tree does for a deity, and the attendant priest, when there is one, generally belongs to one of the half-Hinduized low castes. The rude stone represents the non-Aryan fetish; and the tree seems to owe its sanctity to the non-Aryan belief that it forms the abode of the ghosts or gods of the village.

In all cases the Brahmans enriched the popular symbolism with deep metaphysical doctrines and with admirable moral codes. The great Vishnuvite festival of Bengal, the *rath-jatra*, when Jagannath, "the lord of the world," is dragged in his car to his garden-house, is of Buddhist origin. But it has many a humbler counterpart in the forest excursions which the Bengal villagers make in their holiday clothes to some sacred tree in the neighbouring grove or jungle. These jungle rites find special favour with the low castes, and disclose curious survivals of the non-Hinduized element in the worshippers. Blood sacrifices and the eating of flesh have long been banished from the popular Vishnuvite sects. But on such forest festivals the fierce aboriginal instincts even in the mixed castes, who accept in ordinary life the restraints of Hinduism, break loose. Cowherds have been seen to feed on swine-flesh, which at all other times they regard with abhorrence. The ceremonies, where they can pretend to a conscious meaning, have a propitiatory or necromantic tinge.

The development of Hinduism out of pre-existing religious types, although a natural evolution, bears the impress of human guidance. Until the twelfth century the Brahmans supplied the directing energy in opposition to the Buddhists, and founded their reforms on a reassertion of the personality of God. But by that period Buddhism had ceased to struggle for a separate existence in India, and the mass of the people began to strike out religious sects upon popular rather than on Brahmanical lines. The work of the early Brahman reformers was accordingly carried on after the twelfth century, in part by low-caste apostles, who gave life to the old Brahmanical conception of a personal God by infusing into it the Buddhist doctrine of the spiritual equality of man. Many of the Hindu sects form brotherhoods on the Buddhist model, within which the classification by caste gives place to one based on the various degrees of perfection attained in the religious life. Most of the Hindu reformations since the twelfth century thus preserve what was best in each of the two ancient faiths of India—namely, the personal God of the Brahmans and the spiritual equality of the Buddhists. Among the Hindus every preacher who would really appeal to the popular heart must fulfil two conditions, and conform to a certain type. He must cut himself off from the world by a solemn act, like the great renunciation of Buddha; and he must come forth from his solemn communing with a simple message. The message need not be original, for it must consist of a reassertion, in some form, of the personality of God and the equality of men in his sight.

Hinduism boasts a line of religious founders stretching in almost unbroken succession from about 700 A.D. to the present day. The lives of the mediæval saints and their wondrous works are recorded in the Bhakta-Mala, literally, "The Garland of the Faithful," compiled by Nabhaji, about three centuries ago. It is the Golden Legend and Acta Sanctorum of Hinduism. The same wonders are not recorded of each of its apostles, but divine interpositions abound in the life of all.

One of the most celebrated of the Hindu apostles was Sankara Acharya, who was born in Malabar, and after wandering as an itinerant preacher over India as far as Cashmere, died at Kedarnath in the Himalayas, aged thirty-two. He moulded the later Vedantic philosophy into its final form, and popularized it into a national religion. It is scarcely too much to say, that since his short life in the eighth or ninth century, every new Hindu sect has had to start with a personal God. He addressed himself to the high-caste philosophers on the one hand, and to the low-caste multitude on the other. He left behind, as the two-fold results of his life's work, a compact Brahman sect and a popular religion.

Sankara taught that there was one sole and supreme God, *Brahma Para Brahma*, distinct alike from any member of the old Brahman triad or of the modern Hindu pantheon: the ruler of the universe and its inscrutable first cause, to be worshipped, not by sacrifices, but by meditation, and in spirit and in truth. The Smarta Brahmans follow this philosophic side of his teachings; and of the religious houses which he founded some remain

to this day, controlled from the parent monastery, perched among the western ranges of Mysore. But Sankara realized that such a faith is for the few. To those who could not rise to so high a conception of the godhead, he allowed the practice of any rites prescribed by the Veda, or by later orthodox teachers, to whatsoever form of the godhead they might be addressed. Tradition fondly narrates that the moulders of almost all the historical sects of Hinduism—Sivaites, Vishnuvites, Suaras, Saktas, Ganapatya, Bhairavas—were his disciples. Siva is the Rudra of the Vedas, as developed by Brahman philosophy, and finally adapted to popular worship. Rudra, the storm-god of the Vedic hymns, had grown during this process into Siva, the destroyer and reproducer, as the third person of the Brahman triad.

In the hands of Sankara's followers and apostolic successors, Siva-worship became one of the two chief religions of India. As at once the destroyer and reproducer, Siva represented profound philosophical doctrines, and was early recognized as being in a special sense the god of the Brahmans. To them he was the symbol of death as merely a change of life. On the other hand, his terrible aspects, preserved in his long list of names, from the Roarer (Rudra) of the Veda to the Dread One (Bhima) of the modern Hindu pantheon, well adapted him to the religion of fear and propitiation prevalent among the ruder non-Aryan races. Siva, in his twofold character, thus became the deity alike of the highest and of the lowest castes. He is the Maha-deva, or great god of modern Hinduism; and his wife is Devi, pre-eminently the goddess. His images partake of his double nature. The Brahmanical conception is represented by his attitude as a fair-skinned man, seated in profound thought, the symbol of the fertilizing Ganges above his head and the bull near at hand. The wilder non-Aryan aspects of his character are signified by his necklace of skulls, his collar of twining serpents, his tiger skin, and his club with a human head at the end. His five faces and four arms have also their significance. His wife in like manner appears in her Aryan form as Uma, light, the type of high-born loveliness; in her composite character as Durga, a golden-coloured woman, beautiful but menacing, riding on a tiger; and in her terrible non-Aryan aspects, as Kali, a black fury, of a hideous countenance, dripping with blood, crowned with snakes, and hung round with skulls.

The ritual of Siva-worship preserves, in an even more striking way, the traces of its double origin. The higher minds still adore the godhead by silent contemplation, as prescribed by Sankara, without the aid of external rites. But the low castes pour out the lives of countless victims at the feet of the terrible Kali, and until lately, in time of pestilence and famine, tried in their despair to appease the relentless goddess by human blood. Such sacrifices are now forbidden, alike by Hindu custom and English law, and goats are offered instead. H. H. Wilson found evidence that they were regularly offered by the Kapalika sect of Sivaite Hindus eight centuries ago; and representatives of those hideous votaries of Siva, smeared with ashes from the funeral pile, and their necks hung round with human skulls, survive to this day.

The thirteen chief sects of Siva-worshippers faithfully represent the composite character of their god. Sankara left behind him a succession of teachers, many of whom rose to the rank of religious founders. The Smarta Brahmans still maintain their life of calm monastic piety. The Dandis or ascetics divide their time between begging and meditation. Some of them adore, without rites, Siva as the third person of the Aryan triad; others practise an apparently non-Aryan ceremony of initiation by drawing blood from the inner part of the novice's knee, as an offering to the god in his more terrible form, Bhairava. All Dandis follow the non-Aryan custom of burying their dead, or commit the body to some sacred stream. The Yogis include every class of devotee, from the speechless mystic who, by long suppressions of the breath, loses the consciousness of existence in an unearthly union with Siva, to the impostor who sits upon air, and the juggler who travels with a performing goat. The Sivaite sects descend, through various gradations of self-mortification and abstraction, to the Aghoris, whose abnegation extends to eating carrion and gashing their bodies with knives. The lowest sects follow non-Aryan rather than Aryan types, alike as regards their use of animal food and their bloody worship.

These non-Aryan types are, however, spiritualized into a mystic symbolism by the Sivaite Saktas, or worshippers of the creative energy in nature (Sakti). The right-hand adorers follow the Aryan ritual, with the addition of an offering of blood.

The Kanchuliyas, one of the lowest of the Sivaite sects, not only enforce a community of women, but take measures to prevent the exercise of individual selection, and thus leave the matter entirely to divine chance. Even their orgies, however, are spiritualized into a mystic symbolism; and the dread goddess surely punishes the votary who enters on them merely to gratify his lusts.

Siva-worship thus became a link between the highest and the lowest castes of the Hindus. Vishnu, the second person of the Aryan triad, supplied a religion for the intermediate classes. Siva, as a philosophical conception of the Brahmans, afforded small scope for legend; and the atrocities told of him and his wife in their terrible forms, as adapted to the non-Aryan masses, were little capable of refined literary treatment. But Vishnu, the preserver, furnished a congenial theme for sacred romance. His religion appealed, not to the fears, but to the hopes of mankind. Siva-worship combined the Brahmanical doctrine of a personal God with non-Aryan bloody rites; Vishnu-worship, in its final form as a popular religion, represents the coalition of the same Brahmanical doctrine of a personal God with the Buddhist principle of the spiritual equality of man.

Vishnu had always been a very humane god, from the time when he makes his appearance in the Veda as a solar myth, the unconquerable preserver striding across the universe in three steps. His later incarnations made him the familiar friend of man. Of these descents on earth, ten, or as some say, twenty-two, in number, Vishnu-worship, with the instinct of a popular religion, chose the two most beautiful and most human for adoration. As Rama and Krishna, Vishnu attracted to himself innumerable loving legends. Rama, his seventh incarnation, was the hero of the Sanskrit epic, the Ramayana. In his eighth incarnation, as Krishna, Vishnu becomes the high-souled prince of the other epic, the Mahabharata; he afterwards grew into the central figure of Indian pastoral poetry, was spiritualized into the supreme god of the Vishnuvite Puranas, and now flourishes the most popular deity of the Hindus. The worship of Vishnu, in one form or another, is the religion of the bulk of the middle classes, with its roots deep down in beautiful forms of non-Aryan nature-worship, and its top sending forth branches among the most refined of the Brahmans and literary classes. It is a religion in all things graceful. Its gods are heroes or bright friendly beings, who walk and converse with men. Its legends breathe an almost Grecian beauty. But pastoral simplicities and an exquisite ritual belong to a later age than Siva-worship, with its pandering to the grosser superstitions of the masses. Vishnuvism made its popular conquests at a later period than Sivaite rites.

The "Vishnu Purana," a religious treatise compiled in the eleventh century, declares that there is one God; but he is the God of the Brahmans, to whom he gives the earth as an inheritance, and in his eyes the ruder Indian races

are as naught. This is the general tenor of its doctrines, although more enlightened, perhaps because later, passages occur. I· the "Vishnu Purana" Buddha is still an arch-heretic, who teaches the masses to despise the Veda, but whose disciples are eventually crushed by the bright Aryan gods. It is true that in the concluding book, when treating of the last iron age, to which this world has now come, some nobler idea of God's dealing with man gleams forth. In that time of universal dissolution and darkness, the sage consoles us by the fact that devotion to Vishnu will suffice for salvation to all persons and to all castes.

Vishnuvism had to preach a different doctrine before it could become, as it has for ages been, a religion of the people. The first of the line of Vishnuvite reformers was Ramanuja, a Brahman of Southern India. In the middle of the twelfth century he led a movement against the Sivaites, proclaiming the unity of God, under the title of Vishnu, the cause and the creator of all things.

At the end of the thirteenth century A.D. according to some authorities, or at the end of the fourteenth according to others, the great reformation, which made Vishnu-worship a national religion of India, took place. Ramanand stands fifth in the apostolic succession from Ramanuja, and spread his doctrine through Northern India. He had his headquarters in a monastery at Benares, but wandered from place to place, preaching the one God under the name of Vishnu, and choosing twelve disciples, not from the priests or nobles, but from among the despised castes. One of them was a leather-dresser, another a barber, and the most distinguished of all was the reputed son of a weaver. The list shows that every caste without distinction found free entrance into the new faith. The life of a disciple was no life of ease. He was called upon to forsake the world in a strictly literal sense, and to go about preaching or teaching, and living on alms. His old age found an asylum in some monastery of the brotherhood. Ramanuja had addressed himself chiefly to the pure Aryan castes, and wrote in the language of the Brahmans. Ramanand appealed to the people, and the literature of his sect is in the dialects familiar to the masses. The Hindu vernacular owes its development into a written language partly to the folk-songs of the peasantry and the war-ballads of the Rajput court-bards, but chiefly to the literary requirements of the new popular faith. Vishnuvism has deeply impressed itself on the modern dialects of Northern India.

Kabir, one of the twelve disciples of Ramanand, carried his doctrines throughout Bengal. As his master had laboured to gather together all castes of the Hindus into one common faith, so Kabir, seeing that the Hindus were no longer the whole inhabitants of India, tried about the beginning of the fifteenth century to build up a religion that should embrace Hindu and Mohammedan alike. The writings of his sect acknowledged that the God of the Hindu is also the God of the Mohammedan. His universal name is The Inner, whether he be invoked as the Ali of the Mohammedans or as the Rama of the Hindus. "To Ali and to Rama we owe our life," say the scriptures of his sect, "and should show like tenderness to all who live. What avails it to wash your mouth, to count your beads, to bathe in holy streams, to bow in temples, if, while you mutter your prayers or journey on pilgrimage, deceitfulness is in your heart? The Hindu fasts every eleventh day; the Mussulman on the Ramazan. Who formed the remaining months and days that you should venerate but one? If the Creator dwell in tabernacles, whose dwelling is the universe? The city of the Hindu God is to the east [Benares], the city of the Mussulman God is to the west [Mecca]; but explore your own heart, for there is the God both of the Mussulmans and of the Hindus. Behold but one in all things. He to whom the world belongs, he is the father of the worshippers alike of Ali and of Rama. He is my guide, he is my priest."

Kabir's teaching marks another great stride in the Vishnuvite reformation. His master, Ramanand, had asserted the equality of castes, because he identified the deity with the worshipper. He had regarded the devotee as but a manifestation of the divinity, and no lowness of birth could degrade the godhead. As Vishnu had taken the form of several of the inferior animals, such as the boar and the fish incarnations, so might he be born as a man of any caste. Kabir accepted this doctrine, but he warmed it by an intense humanity. All the chances and changes of life, the varied lot of man, his differences in religion, his desires, hopes, fears, loves, are but the work of *Maya*, or illusion. To recognize the one divine spirit under these manifold illusions, is to obtain emancipation and the rest of the soul. That rest is to be reached, not by burnt-offerings or sacrifice, but, according to Kabir, by faith (*bhakti*), by meditation on the Supreme, by keeping his holy names, Hari, Ram, Govind, for ever on the lips and in the heart.

The labours of Kabir may be placed between 1380 and 1420. In 1485, Chaitanya was born, and spread the Vishnuvite doctrines, under the worship of Jaganmath, throughout the deltas of Bengal and Orissa. Signs and wonders attended Chaitanya through life, and during four centuries he has been worshipped as an incarnation of Vishnu. His doctrine was that no race or caste was beyond the pale of salvation. The Mussulmans shared his labours, and profited by his preaching as well as the Hindus. He held that all men are alike capable of faith, and that all castes by faith become equally pure. Implicit belief and incessant devotion were his watchwords. Contemplation rather than ritual was his pathway to salvation. Obedience to the religious guide is the great characteristic of his sect; but he warned his disciples to respect their teachers as second fathers, and not as gods. The great end of his system, as of all Indian forms of worship, is the liberation of the soul. He held that such liberation does not mean the mere annihilation of separate existence. It consists in nothing more than an entire freedom from the stains and the frailties of the body. The liberated soul dwells for ever, either in a blessed region of perfect beauty and sinlessness, or it soars into the heaven of Vishnu himself, high above the myths and mirages of this world, where God appears no more in his mortal incarnations, or in any other form, but is known in his supreme essence.

The followers of Chaitanya belong to every caste, but they acknowledge the rule of the descendants of the original disciple (*gosains*). The sect is open alike to the married and unmarried. It has its celibates and wandering mendicants, but its religious teachers are generally married men. They live with their wives and children in clusters of houses around a temple to Krishna; and in this way the adoration of Chaitanya has become a sort of family worship throughout Orissa. The landed gentry worship him with a daily ritual in household chapels dedicated to his name. The most important doctrine of the sect is their recognition of the value of women as instructors of the outside female community. For long they were the only teachers admitted into the *zananas* of good families in Bengal. Fifty years ago they had effected a change for the better in the state of female education, and the value of such instruction was assigned as the cause of the sect having spread in Calcutta. Since that time Vishnuvite female ascetics of various sorts have entered the same field.

The death of Chaitanya marked the beginning of a spiritual decline in Vishnu-worship. About 1520 Vallabha-Swami preached in Northern India that the liberation of the soul did not depend upon the mortification of the body; and that God was to be sought, not in nakedness and hunger and solitude, but amid the enjoyments of this life. An opulent sect had, from an early period, attached itself to the worship of Krishna and his mistress Radha, a mystic significance being, of course, assigned to their pastoral

loves. Still more popular among women is the modern adoration of Krishna as the Bala Gopala or the infant cowherd, perhaps unconsciously stimulated by the Christian tradition of the divine child. Another influence of Christianity on Hinduism may possibly be traced in the growing function assigned by the Krishna sects to *bhakti*, or faith, as an all-sufficient instrument of salvation.

Vallabha-Swami was the apostle of Vishnuvism as a religion of pleasure. When he had finished his life's work he descended into the Ganges; a brilliant flame arose from the spot, and, in the presence of a host of witnesses, his glorified form ascended to heaven. The special object of his homage was Vishnu in his pastoral incarnation, in which he took the form of the divine youth Krishna, and led an arcadian life in the forest. Shady bowers, lovely women, exquisite viands, and everything that appeals to the luscious sensuousness of a tropical race, are mingled in his worship. His daily ritual consists of eight services, in which Krishna's image, as a beautiful boy, is delicately bathed, anointed with essences, splendidly attired, and sumptuously fed. The followers of the first Vishnuvite reformers dwelt together in secluded monasteries, and went about scantily clothed, living upon alms. But this sect performs its devotions arrayed in costly apparel, anointed with oil, and perfumed with camphor or sandal. It seeks its converts, not among weavers, or leather-dressers, or barbers, but among wealthy bankers and merchants, who look upon life as a thing to be enjoyed, and upon pilgrimage as a holiday excursion or an opportunity for trade.

In a religion of this sort abuses are inevitable. It was a revolt against a system which taught that the soul could approach its Maker only by the mortification of the body. It declared that God was present in the cities and marts of men, not less than in the cave of the ascetic. Faith and love were its instruments of salvation, and voluptuous contemplation its approved spiritual state. It delighted to clothe the deity in a beautiful human form, and mystical amorous poems make a large part of its canonical literature. One of its most valued theological treatises is entitled "The Ocean of Love" (*Prem Sagar*); and although its nobler professors always recognize its spiritual character, to baser minds it has become simply a religion of pleasure. The loves of Radha and Krishna, that woodland pastoral, redolent of a wild-flower aroma as ethereal as the legend of Psyche and Cupid, are sometimes materialized into a sanction for licentious rites.

The worship of Siva and Vishnu operates as a religious bond among the Hindus, in the same way as caste supplies the basis of their social organization. Theoretically the Hindu religion starts from the Veda, and acknowledges its divine authority. But, practically, we have seen that Hinduism takes its origin from many sources. Vishnu-worship and Sivaite rites represent the two most popular combinations of these various elements. The highly cultivated Brahman is a pure theist; the less cultivated worships the divinity under some chosen form, *ishta-devata*. The conventional Brahman, especially in the south, takes as his "chosen deity" Siva in his deep philosophical significance. The middle classes and the mercantile community adore some incarnation of Vishnu. The low castes propitiate Siva the destroyer, or rather one of his female manifestations, such as the dread Kali.

Of the three members of the Hindu triad, the first person, Brahma, has now but a few scattered handfuls of followers; the second person, Vishnu, supplies a worship for the middle classes; around the third person, Siva, in his twofold aspects, has grown up that mixture of philosophical symbolism with propitiatory rites professed by the highest and by the lowest castes. But the educated Hindu willingly recognizes that, beyond and above his chosen person of the triad, or his favourite incarnation, or his village fetish, or his household *salagram*, dwells the Param-eswara, the One First Cause, whom the eye has not seen and whom the mind cannot conceive, but who may be worshipped in any one of the forms in which he has made his power manifest to men.

A barbarous and unnatural custom in India, principally among the Hindus, is that which compels the marriage of mere children, and which it is to be hoped will become less marked as time rolls on, and as the people, by education, obtain a gradual knowledge of the ethics of civilized nations. The result of this custom is shown by the last census in the number of widows and their ages belonging to the Hindu race. Under ten years of age there are no fewer than 63,000; between ten and fifteen, 174,524; between fifteen and twenty, 312,621; and between twenty and thirty, 1,572,145. What makes the custom still more reprehensible is the fact that this great host of widows is prohibited from marrying a second time. Infanticide of female infants formerly prevailed to a very great extent, but the crime is now almost stamped out.

Wealthy Hindus are often lavishly ostentatious when a death, a marriage, or one of the annual religious festivals offers them an occasion for parading their generosity. They illuminate gardens that reflect the pleasures of their paradise; they throw their mansions open to all comers; they feed troops of beggars and priests for days, and sometimes for weeks. And although the Bengali, as a rule, is frugal to stinginess, looking closely to the expenditure of each rupee, the observances of his faith must be a heavy tax on him.

Christianity in India.—The total number of Christians in India, British and feudatory, according to official returns, is about 1,650,000. According to the missionary returns, the Roman Catholics claim 1,320,000, and the Protestants about 350,000. Christians are most numerous in the south, especially in Travancore and Cochin. The Dravidian peoples have always been most accessible to Christian teaching. In British India the percentage of Christians is highest in Tinnevelli, where it reaches 6 per cent. The cost of the Indian Ecclesiastical Department is a little over £200,000 a year; and in addition the government pays or subsidizes Roman Catholic priests as chaplains to the troops in many military stations, and also missionaries and ministers of various denominations in stations where there are no chaplains. It also builds, furnishes, and repairs churches, both Catholic and Protestant, for the use of soldiers, or pays for their sittings.

The origin of Christianity in India is obscure. Early tradition, accepted universally by Catholics and generally by Protestants, connects it with St. Thomas the apostle, who is said to have preached in the Malayalam country, in Tinnevelli, and on the east coast; to have founded several churches; and finally, to have been martyred at the Little Mount, near Madras. The Catholic tradition narrates further, that a persecution arose not long after, in which all the priests perished. Many years later, the patriarch of Babylon, then in communion with Rome, heard of the desolate state of the church, and sent them bishops of the Chaldean or Syrian rite, the existence of which to the present day in the Malayalam country is thus explained. About 486 A.D. Nestorianism spread from Babylon into Malabar.

Modern authorities are not wanting who consider that there is no evidence for St. Thomas' labours in Madras or India Proper; and certainly, in the early writers, the word India had a wide application, and might mean several parts of Asia. They maintain that the first Indian Christians were Manicheans or Gnostics. Afterwards, when Nestorianism prevailed in Persia, it spread into Southern India; and numerous references are made to Nestorians in India by the travellers of the middle ages. Our own Alfred the Great sent Sighelm of Sherburn to the shrine of St. Thomas in India in 883 A.D.

The first Roman Catholic mission arrived in India from Portugal in 1500, and was composed of Franciscan monks. In the same year Father Pedro de Covilham was martyred. For some time their work was almost confined to the Portuguese settlements, although King Emmanuel (1498–1521) and his son John III. (1521–57) had much at heart the conversion of the Indians. The first bishop in India was Duarte Nunez, a Dominican (1514–17); and John de Albuquerque, a Franciscan, was the first bishop of Goa (1539–53). With St. Francis Xavier, who arrived in 1542, began the labours of the Society of Jesus in the East, and the progress of Christianity became more rapid. St. Francis' name is associated with the Malabar coast, and with the maritime tracts of Madura and Southern Madras. He completed the conversion of the Paravars in Tinnevelli district. His tomb is at Goa. Punnaikayal, in Tinnevelli, was the scene in 1549 of the death of Father Antonio Criminale, the protomartyr of the Society of Jesus, and in the following year several others sacrificed their lives in preaching the gospel. Goa became an archbishopric in 1577. But for the labours of the Catholic priests the Nestorians above mentioned would have relapsed into heathenism. About 1596 the Archbishop of Goa, Alexis de Menezes, an Augustinian, succeeded in reconciling the Indian Nestorians to Rome; and at the Synod of Diamper (Udayompura, near Cochin), in 1599, the affairs of the Indian Christians were settled. The use of the Syrian rite was retained after it had been purged of its Nestorianism. About fifty years later emissaries from Babylon caused the whole community to relapse into Nestorianism; and the wars between the Dutch and Portuguese at this time impeded the action of the Catholic missionaries. But in 1660 a mission of Carmelite priests arrived, and succeeded in recovering nearly all the Indian Christians to Rome.

A certain number cling to the Nestorian rite to this day, and are split up into various factions, with several rival bishops, whose disputes come from time to time before our courts. These divisions have not been cemented by the labours of the Church Missionary Society, which from 1816 to 1838 fostered a connection with the Nestorians, and gave liberal aid to their schools.

The Jesuit mission to the Madras coast dates from 1606, and is associated with the names of Robert de Nobili (its founder, who died in 1656), John de Britto (martyred in Madura 1693), Beschi the great scholar (who died about 1746), and other illustrious Jesuits, chiefly Portuguese. They laboured in Madura, Trichinopoli, Tanjore, Tinnevelli, Salem, &c. The mission of the Karnatak, also a Jesuit mission, was French in its origin, and due in some measure to Louis XIV. in 1700. Its centre was Pondicherri. The early Jesuit missions are particularly interesting. Their priests and monks became perfect Indians in all secular matters, dress, food, &c., and had equal success among all castes, high and low. The letters of the Jesuits form for a long period the chief materials for the social history of the southern districts. They had also numerous, although less important, missions in the north of India. During the seventeenth and eighteenth centuries religious troubles and difficulties arose in Southern India through the action of the missionaries as to caste observances, which were misrepresented in Europe. The Portuguese government claimed to appoint the Archbishop of Goa, and the Dutch adventurers persecuted the Catholics along the coast. The literary activity of the missionaries was, however, very great. Their early efforts in the cause of education, and in printing books in the various languages, are remarkable. The work of the missions was brought to a termination by political events in Europe.

In 1759, Portugal broke up the Society of Jesus within its dominions, seized its property, and imprisoned its members. France did the same in 1764; and to prevent greater evils, Clement XIV. in 1773 was forced to suppress the whole society. The French Revolution followed. These events deprived the Indian Jesuit missions alike of priests and of resources, and for a long time they languished, served in the south only by a few priests from Goa and Pondicherri. That dismal period, however, presents some illustrious names; among them two well-known writers, the Abbé Dubois of Mysore, and the Carmelite Fra Paolino de San Bartolommeo (in India, 1774–90). In the absence of priests to sustain the courage of the Christians, every occasional or local persecution told. Tippoo, about 1784, forcibly circumcised about 30,000 Catholics of Kanara, and deported them to the country above the Ghats. Many native Christians lived and died without ever seeing a priest; they baptized their own children, taught them the prayers, and kept up daily worship in their churches. In 1814, the Society of Jesus was re-established; and under Gregory XVI. (1831–46) its missions began a new life, and have since made great progress. Their prosperity is, however, much hampered by the action taken in Europe against the religious orders. The claims of Portugal to appoint the Archbishop of Goa, and through him to regulate the clerical patronage, as opposed to the claims of the pope, have occasioned schisms in the past, and still give rise to discord. The native Roman Catholics, as already stated, number about 1,320,000.

Roman Catholic missions are maintained by many of the European nations, and are nearly equally divided between the secular and regular clergy. Almost every mission contains a mixture of races among its priests, even Holland, Spain, and Germany being represented. Although all are directed by Europeans, at least seven-eighths of the Roman priests are natives. It is also worthy of remark that in the list of bishops during the last 300 years the names of several natives are found, some of them Brahmans. The Roman Catholic missions are presided over by bishops (vicars and prefects apostolic), the delegates of the pope, who governs the missions himself without the intervention of the hierarchy.

The Catholics in India seem steadily to increase; and as in former times, the increase is chiefly in the south, especially in the missions of Pondicherri and Madura. The Roman Catholic priests deny themselves the comforts considered necessaries for Europeans in India. In many districts they live the frugal and abstemious life of the natives, and their influence reaches deep into the social life of the communities among whom they dwell.

The first Protestant missionaries in India were Lutherans, Ziegenbalg and Plutschau, who in 1705 began work under the patronage of the King of Denmark at the Danish settlement of Tranquebar. Ziegenbalg and many of the early Lutheran missionaries were men of great ability; and, besides their translations of the Scriptures, some of their writings still hold a high place in missionary literature. In 1750 arrived the pious Schwartz, whose name is bound up with the history of Tanjore and adjacent districts until his death in 1798. He was the founder of the famous Tinnevelli missions. Next to the Lutherans come the Baptists of Serampur, with the honoured names of Carey, Marshman, and Ward. In the eighteenth century the English East India Company did not at first discourage the labours of Protestant missionaries. It had allowed Kiernander, who was sent by the Danish mission, to establish himself at Calcutta in 1758; but subsequently it put every obstacle in the way of missionaries, and deported them back to England on their landing. Carey arrived in 1793. In 1799, to avoid the opposition of the East India Company, he established himself with four other missionaries at Serampur (15 miles from Calcutta), at that time, like Tranquebar, a Danish possession. Then began that wonderful literary activity which has rendered illustrious the group of Serampur missionaries. In ten years the Bible,

or parts of it, was translated and printed in thirty-one languages, and by 1816 the missionaries had about 700 converts. The London Missionary Society (established 1795) entered the field in 1798, and its missions have gradually grown into importance.

The opposition of the company continued until 1813, when it was removed by the new charter. The same document provided for the establishment of the bishopric of Calcutta and three archdeaconries, one for each presidency. Up to this period the Established Church of England had attempted no direct missionary work, although some of the East India Company's chaplains had been men of zeal, like the ardent Henry Martyn (1806–11). The first bishop of Calcutta (Middleton) arrived in 1814. From this time the Church of England has kept up a missionary connection with India, chiefly by means of its two great societies—the Church Missionary Society, which sent out its first representative in 1814, and the Society for the Propagation of the Gospel, which did so in 1826. Their most successful missions are in southern India, where they have gathered in the seed sown by the Lutheran missions. The second bishop of Calcutta was the well-known Heber (1823–26). In 1835, under a new charter of the East India Company, the see of Madras was established, and in 1837 that of Bombay. In 1877, owing to the extension of mission work in Tinnevelli, two missionaries were appointed bishops, as assistants to the Bishop of Madras; the dioceses of Lahore and Rangoon were separated from Calcutta, and bishops appointed. The missionary bishopric of Travancore and Cochin was established in 1879. It has no connection with government, nor have the assistant bishops in Madras.

The first missionary of the Church of Scotland was Dr. Alexander Duff (1830–63), to whom the use of English as the means of higher education in India is mainly due. Missionaries of numerous other Protestant societies (European and American) have since entered India, and established numbers of churches and schools. They have furnished memorable names to the roll of Indian educators, such as Judson (Baptist) in Burma, 1813–50, and John Wilson (Presbyterian) of Bombay, 1843–75.

Education.—At no period of its history has India been without some system of popular education, and through all changes of government vernacular instruction has always been given, at least to the children of the respectable classes, in every large village, and British efforts to stimulate education have been most successful, when based upon the existing indigenous institutions. During the early days of the East India Company's rule the promotion of education was not recognized as a duty of government. The Christian missionaries made the field of vernacular education their own. Discouraged by the authorities, and under the company liable to deportation, they not only devoted themselves with courage to their special work of evangelization, but they were also the first Europeans to study the vernacular dialects spoken by the people. This they did in order to preach to them and to translate the Bible; they also taught English, as the channel of Western knowledge.

After long and acrimonious controversy between the advocates of English and of vernacular teaching, the present system was based, in 1854, upon a comprehensive despatch sent out by Sir Charles Wood (afterwards Lord Halifax). Schools for teaching English were by degrees established in every district; grants-in-aid were extended to the lower vernacular institutions, and to girls' schools; and public instruction was erected into a department in every province, under a director, with a staff of inspectors. In some respects this scheme may have been in advance of the time; but it supplied a definite outline, which has gradually been filled up. A network of schools has now been extended over the country, graduated from the indigenous village institutions up to the highest colleges. All alike receive some measure of pecuniary support, granted under the guarantee of regular inspection; while a series of scholarships at once stimulates efficiency, and opens a path to the university for the children of the poor. There are now over 70,000 educational institutions in India attended by about 2,000,000 pupils—or one pupil to every hundred of the population.

The three universities of Calcutta, Madras, and Bombay were incorporated in 1857, on the model of the University of London. They are merely examining bodies, with the privilege of conferring degrees in arts, law, medicine, and civil engineering. Of late years something has been done, although not much, to extend the advantages of education to girls in India. In this, as in other educational matters, the missionaries have been the pioneers of progress. In a few exceptional places, such as Tinnevelli in Madras, the Khasi Hills of Assam, and among the Karen tribes of Burma, female education has made real progress; for in these localities the missionaries have sufficient influence to overcome the prejudices of the people. But elsewhere, even in the large towns and among the English-speaking classes, all attempts to give a modern education to women are regarded with scarcely disguised aversion, and have obtained but slight success. Throughout the north-western provinces, with their numerous and wealthy cities, and a total female population of 15,000,000, less than 10,000 girls attend school. In Bengal, with just double the inhabitants, the corresponding number was less than 20,000.

Newspapers.—Closely connected with the subject of education is the steady growth of the vernacular press, which is ever active in issuing both newspapers and books. The missionaries were the first to cast type in the vernacular languages and to employ native compositors. The earliest vernacular newspaper was issued in Bengali by the Baptist Mission at Serampur, in 1818. For many years the vernacular press preserved the marks of its origin, being limited almost exclusively to theological controversy. The missionaries were encountered with their own weapons by the theistic sect of the Brahmo Somaj, and also by the orthodox Hindus. So late as 1850 most of the vernacular newspapers were still sectarian rather than political. But during the last thirty years the vernacular press has gradually risen into a powerful engine of political discussion. The number of newspapers regularly published in the several vernaculars is about 250. In Bengal, the vernacular press suffers from the competition of English newspapers, some of which are entirely owned and written by natives. In the north-west, from Lucknow to Lahore, about 100 newspapers are printed in Hindustani or Urdu, the vernacular of the Mohammedans throughout India. Many of them are conducted with considerable ability and enterprise, and may fairly be described as representative of native opinion in the large towns. The Bombay journals are almost equally divided between Marhatti and Gujerati. Those in the Marhatti language are characterized by the traditional independence of the race of Sivaji; the Gujerati newspapers are the organs of the Parsis, and of the trading community generally. The vernacular newspapers of Madras, printed in Tamil and Telugu, are politically unimportant, being still for the most part devoted to religion.

History.—The external history of India commences with the Greek invasion in 327 B.C. Some indirect trade between India and the Mediterranean seems to have existed from very ancient times. Homer was acquainted with tin and other articles of Indian merchandise by their Sanskrit names; and a long list has been made of Indian products mentioned in the Bible. But the first Greek historian who speaks clearly of India is Hekataios of Miletos (549–486 B.C.); the knowledge of Herodotus (450 B.C.) ended at

the Indus; and Ktesias, the physician (401 B.C.), brought back from his residence in Persia only a few facts about the products of India, its dyes and fabrics, monkeys and parrots. India to the east of the Indus was first made known to Europe by the historians and men of science who accompanied Alexander the Great in 327 B.C. Their narratives, although now lost, are condensed in Strabo, Pliny, and Arrian. Soon afterwards, Megasthenes, as Greek ambassador resident at a court in the centre of Bengal (306–298 B.C.), had opportunities for the closest observation. The knowledge of the Greeks and Romans concerning India practically dates from his researches, 300 B.C. In what follows modern, not classical, names are used, for clearness' sake.

Alexander the Great entered India early in 327 B.C.; crossed the Indus above Attock, and advanced, without a struggle, over the intervening territory of the Taxiles, to the Jhelum (Hydaspes). He found the Punjab divided into petty kingdoms jealous of each other, and many of them inclined to join an invader rather than to oppose him. One of these local monarchs, however, Porus (*Pôros* in the Greek), disputed the passage of the Jhelum with a force which, substituting chariots for guns, about equalled the army of Runjit Singh, the ruler of the Punjab in the present century. Plutarch gives a vivid description of the battle from Alexander's own letters. Having drawn up his troops at a bend of the Jhelum, about 14 miles west of the modern field of Chilianwala, the Greek general crossed under shelter of a tempestuous night. The chariots hurried out by Porus stuck in the muddy bank of the river. In the engagement which followed the elephants of the Indian prince refused to face the Greeks, and, wheeling round, trampled his own army under foot. His son fell early in the onset; Porus himself fled wounded; but on tendering his submission, he was confirmed in his kingdom, and became the conqueror's trusted friend. Alexander built two memorial cities on the scene of his victory—Boukephala on the west bank, near the modern Jalalpur, named after his beloved charger Bucephalus (*Boukephalos*), slain in the battle; and Nikaia, the present Mong, on the east side of the river.

Alexander advanced south-east through the kingdom of the younger Porus to Amritsar, and after a sharp bend backward to the west, to fight the Kathaei at Sangala, he reached the Beas (Hyphasis). Here, at a spot not far from the modern battlefield of Sobraon, he halted his victorious standards. He had resolved to march to the Ganges; but his troops were worn out by the heats of the Punjab summer, and their spirits broken by the hurricanes of the south-west monsoon. The native tribes had already risen in his rear, and the conqueror of the world was forced to turn back before he had crossed even the frontier province of India. The Sutlej, the eastern districts of the Punjab, and the mighty Jumna still lay between him and the Ganges. A single defeat might have been fatal to his army; if the battle on the Jhelum had gone against him, not a Greek would probably have reached the Afghan side of the passes. Yielding at length to the clamour of his men, he led them back to the Jhelum. He there embarked 8000 of his troops in boats previously prepared, and floated them down the river; the remainder marched in two divisions along the banks.

The country was hostile, and the Greeks held only the land on which they encamped. At Multan, then as now the capital of the Southern Punjab, he had to fight a pitched battle with the Malli, and was severely wounded in taking the city. His enraged troops put every soul within it to the sword. Further down, near the confluence of the five rivers of the Punjab, he made a long halt, built a town—Alexandria, the modern Uchh—and received the submission of the neighbouring states. A Greek garrison and satrap, which he here left behind, laid the foundation of a lasting influence. Having constructed a new fleet, suitable for the greater rivers on which he was now to embark, he proceeded southwards through Sind, and followed the course of the Indus until he reached the ocean. In the apex of the delta he founded or refounded a city, Patala, which survives to this day as Hyderabad, the capital of Sind.

The Greeks observed with admiration the absence of slavery in India, the chastity of the women, and the courage of the men. In valour they excelled all other Asiatics; they required no locks to their doors; above all, no Indian was ever known to tell a lie. Sober and industrious, good farmers and skilful artisans, they scarcely ever had recourse to a lawsuit, and lived peaceably under their native chiefs. The kingly government is portrayed almost as described in Manu, with its hereditary castes of councillors and soldiers.

The chronology of the twelve centuries intervening between the Greco-Bactrian period and the Mohammedan conquest still depends on a mass of conflicting evidence derived from the inscriptions, legendary literature, unwritten traditions, and coins. In the midst of the confusion we see dim masses moving southwards from Central Asia into India. The Greco-Bactrian kings are traced by coins as far as Muttra on the Jumna. Their armies occupied for a time the Punjab, as far south as Gujerat and Sind.

Mohammedan Rule in India.—While Buddhism was giving place to Hinduism in India, as previously described, a new faith had arisen in Arabia. Mohammed, born in 570, created a conquering religion, and died in 632. Within 100 years after his death, his followers had invaded the nations of Asia as far as the Hindu-Kush. Here their progress was stayed, and Islam had to consolidate itself, during three more centuries, before it grew strong enough to grasp the rich prize of India. This long delay was due, not only to the daring of individual tribes, such as the Sind Rajputs, but to the military organization of the Hindu kingdoms.

Each of these groups of kingdoms, alike in the north and in the south, had a certain power of coherence to oppose to a foreign invader; while the large number of the groups and units rendered conquest a very tedious process. For even when the over-lord or central authority was vanquished, the separate groups and units had to be defeated in detail, and each supplied a nucleus for subsequent revolt. The Hindu power in Southern India was not completely broken till the battle of Talikot in 1565; and within 100 years, in 1650, the great Hindu revival had commenced which, under the form of the Marhatta confederacy, was destined to break up the Mogul Empire in India. That empire, even in the north of India, had only been consolidated by Akbar's policy of incorporating Hindu chiefs and statesmen into his government (1556–1605). Up to his time, and during the earlier years of his reign, a series of Rajput wars had challenged the Mohammedan supremacy. In less than two centuries the successor of Akbar was a puppet and a prisoner in the hands of the Hindu Marhattas at Delhi.

The popular notion that India fell an easy prey to the Mussulmans is opposed to the historical facts. Mohammedan rule in India consists of a series of invasions and partial conquests, during eleven centuries, from Usman's raid in 636 to Ahmed Shah's tempest of invasion in 1761. They represent in Indian history the overflow of the nomad tribes of Central Asia to the south-east; as the Huns, Turks, and various Tartar tribes disclose in early European annals the westward movements from the same great breeding-ground of nations. At no time was Islam triumphant throughout all India. Powerful Hindu dynasties ruled over a large area. At the height of the Mohammedan power the Hindu princes paid tribute, and sent agents to

the imperial court. But even this modified supremacy of Delhi lasted for little over a century (1578–1707). Before the end of that brief period the Hindus had again begun the work of reconquest. The native chivalry of Rajputana was closing in upon Delhi from the south-east; the religious confederation of the Sikhs was growing into a military power on the north-west. The Marhattas combined the fighting powers of the low castes with the statesmanship of the Brahmans, and subjected the Mohammedan kingdoms throughout India to tribute. So far as can now be estimated, the advance of the English power at the beginning of the present century alone saved the Mogul Empire from passing to the Hindus.

While the Mohammedan governors and Hindu subjects of the Mogul Empire were asserting their independence, two new sets of external enemies appeared. The first of these consisted of invasions from the north-west. In 1739 Nadir Shah, the Persian, swept down with his destroying host, and, after a massacre in the streets of Delhi and a fifty-eight days' sack, went off with a booty estimated at £32,000,000 sterling. Six times the Afghans burst through the passes under Ahmed Shah Durani, plundering, slaughtering, and then scornfully retiring to their homes with the plunder of the empire. In 1738 Cabul, the last Afghan province of the Moguls, was severed from Delhi; and in 1752 Ahmed Shah obtained the cession of the Punjab. The cruelties inflicted upon Delhi and Northern India during these six invasions form an appalling tale of bloodshed and wanton cruelty. The miserable capital opened her gates, and was fain to receive the Afghans as guests. Yet on one occasion it suffered for six weeks every enormity which a barbarian army can inflict upon a prostrate foe. Meanwhile the Afghan cavalry were scouring the country, slaying, burning, and mutilating in the meanest hamlet as in the greatest town. They took especial delight in sacking the holy places of the Hindus, and murdering the defenceless votaries at the shrines.

The other set of invaders came from the sea. In the wars between the French and English in Southern India, the last vestiges of the Delhi authority in the Madras Presidency disappeared (1748–61). Bengal, Behar, and Orissa were handed over to the English by an imperial grant in 1765. They technically held these fertile provinces as the nominee of the emperor; but the battle of Panipat had already reduced the throne of Delhi to a shadow. This battle was fought in 1761, between the Afghan invader Ahmed Shah and the Marhatta powers, on the memorable plain on which Babar and Akbar had twice won the sovereignty of India. That sovereignty was now, in 1761, lost for ever to their degenerate descendants. The Afghans defeated the Marhattas; and during the anarchy which followed, the British patiently built up a new power out of the wreck of the Mogul Empire. Mogul pensioners and puppets reigned at Delhi over a numerous seraglio, under such lofty titles as Akbar II. or Alamgir (Aurungzebe) II. But their power was confined to the palace, while Marhattas, Sikhs, and Englishmen struggled for the sovereignty of India. The last nominal emperor emerged for a moment as a rebel during 1857, and died a state prisoner in Rangoon, the capital of British Burma, in 1862.

The British won India, not from the Moguls, but from the Hindus. Before they appeared as conquerors the Mogul Empire had broken up. The final and most perilous wars of the British were neither with the Delhi king nor with his revolted governors, but with the two Hindu confederacies, the Marhattas and the Sikhs. Mohammedan princes fought with the English in Bengal, the Karnatak, and Mysore. The last Marhatta war dates as late as 1818, and the Sikh confederation was overcome only in 1848.

The Mohammedan invaders of India had entered from the north-west. Her Christian conquerors approached by the sea from the south. From the time of Alexander to that of Vasco da Gama, Europe held little direct intercourse with the East. An occasional traveller brought back stories of powerful kingdoms and of untold wealth; but the passage by sea was scarcely dreamed of, and by land wide deserts and warlike tribes lay between. Commerce, indeed, never ceased entirely, being carried on chiefly by the Italian cities on the Mediterranean, which traded to the ports of the Levant. But to Europeans of the fifteenth century India was an unknown land, which powerfully attracted the imagination of spirits stimulated by the renaissance and ardent for discovery. An expedition under Vasco da Gama started from Lisbon in 1497, doubled the Cape of Good Hope, and cast anchor off the city of Calicut on the 20th May, 1498, after a protracted voyage of nearly eleven months. An earlier Portuguese emissary, Covilham, had reached Calicut overland about 1487.

After staying nearly six months on the Malabar coast, Da Gama returned to Europe, bearing with him the following letter from the Zamorin to the King of Portugal:—"Vasco da Gama, a nobleman of your household, has visited my kingdom and has given me great pleasure. In my kingdom there is abundance of cinnamon, cloves, ginger, pepper, and precious stones. What I seek from thy country is gold, silver, coral, and scarlet." A second expedition, consisting of thirteen ships and 1200 soldiers, under the command of Cabral, was despatched in 1500. "The sum of his instructions was to begin with preaching, and if that failed, to proceed to the sharp determination of the sword." On his outward voyage Cabral was driven by stress of weather to the coast of Brazil. Ultimately he reached Calicut, and established factories both there and at Cochin, in spite of active hostility from the natives.

In 1503 Alfonso d'Albuquerque sailed to the East in command of one of three expeditions from Portugal. In 1505 a large fleet of twenty-two sail and 15,000 men was sent under Francisco de Almeida, the first Portuguese governor and viceroy of India. In 1509 Albuquerque succeeded as governor, and widely extended the area of Portuguese influence. Having failed in an attack upon Calicut he seized Goa in 1510, which has since remained the capital of Portuguese India.

For exactly a century, from 1500 to 1600, the Portuguese enjoyed a monopoly of Oriental trade. But the Portuguese had neither the political strength nor the personal character necessary to maintain such an empire. Their national temper had been formed in their contest with the Moors at home. They were not traders, but knights-errant and crusaders, who looked on every pagan as an enemy of Portugal and of Christ. Only those who have read the contemporary narratives of their conquests can realize the superstition and the cruelty with which their history in the Indies is stained. Albuquerque alone endeavoured to conciliate the goodwill of the natives, and to live in friendship with the Hindu princes, who were naturally better pleased to have the Portuguese, as governed by him, for their neighbours and allies, than the Mohammedans whom he had expelled or subdued. The justice and magnanimity of his rule did as much to extend and confirm the power of the Portuguese in the East as the courage and success of his military achievements. In such veneration was his memory held that the Hindus of Goa, and even the Mohammedans, were wont to repair to his tomb, and there utter their complaints, as if in the presence of his shade, and call upon God to deliver them from the tyranny of his successors. The cruelties of Soarez, Sequeyra, Menezes, Da Gama, and succeeding viceroys, drove the natives to desperation, and encouraged the princes of Western India in 1567 to form a league against the Portuguese, in which they were joined by the King of Acheen. But the undisciplined Indian troops were unable

to stand against the veteran soldiers of Portugal, 200 of whom, at Malacca, utterly routed 15,000 natives with artillery.

In 1580 the Portuguese crown was united with that of Spain under Philip II. This proved the last blow to the maritime and commercial supremacy of Portugal. The interests of Portugal in Asia were henceforth subordinated to the European interests of Spain. In 1640 Portugal again became a separate kingdom. But in the meanwhile the Dutch and English had appeared in the Eastern seas, and before their indomitable competition the Portuguese Empire of the Indies withered away as rapidly as it had sprung up.

The Dutch were the first European nation who broke through the Portuguese monopoly. Private companies for trade with the East were formed, and in 1602 they were all amalgamated by the states-general into The Dutch East India Company.

During the seventeenth century the Dutch maritime power was the first in the world. Their memorable massacre of the English at Amboyna, in 1623, forced the British company to retire from the Eastern Archipelago to the Continent of India, and thus led to the foundation of our Indian Empire. The long naval wars and bloody battles between the English and the Dutch, within the narrow Eastern seas, were not terminated until William of Orange united the two countries in 1689.

The fall of the Dutch colonial empire resulted from its short-sighted commercial policy. It was deliberately based upon a monopoly of the trade in spices, and remained from first to last destitute of sound economical principles. Like the Phœnicians of old, the Dutch stopped short of no acts of cruelty towards their rivals in commerce; but, unlike the Phœnicians, they failed to introduce their civilization among the natives with whom they came in contact. The knell of Dutch supremacy was sounded by Clive, when in 1758 he attacked the Dutch at Chinsura both by land and water, and forced them to an ignominious capitulation.

The earliest English attempts to reach India were made by the north-west passage. In 1496 Henry VII. granted letters patent to John Cabot and his three sons (one of whom was the famous Sebastian) to fit out two ships for the exploration of this route. Many subsequent attempts were made to find a north-west passage, but all were unsuccessful. In 1583 three English merchants, Ralph Fitch, James Newberry, and Leedes, went out to India overland as mercantile adventurers. The jealous Portuguese threw them into prison at Ormuz, and again at Goa. At length Newberry settled down as a shopkeeper at Goa; Leedes entered the service of the Great Mogul; and Fitch, after a lengthened peregrination in Ceylon, Bengal, Pegu, Siam, Malacca, and other parts of the East Indies, returned to England.

In 1599 the Dutch, who had then firmly established their trade in the East, raised the price of pepper against the English from 3*s*. per lb. to 6*s*. and 8*s*. The merchants of London held a meeting on the 22nd September, at Founders' Hall, with the lord mayor in the chair, and agreed to form an association for the purposes of trading directly with India. Queen Elizabeth also sent Sir John Mildenhall by Constantinople to the Great Mogul to apply for privileges for an English company. On the 31st December, 1600, the English East India Company was incorporated by royal charter under the title of "The Governor and Company of Merchants of London trading to the East Indies." The history of the company as a commercial undertaking has already been described under EAST INDIA COMPANY. Factories were established at various places, notwithstanding the opposition of the Dutch and Portuguese, and in 1619 a treaty of defence with the Dutch, to prevent disputes between the English and Dutch companies, was ratified. When it was proclaimed in the East, hostilities solemnly ceased for the space of an hour, while the Dutch and English fleets, dressed out in all their flags, and with yards manned, saluted each other. But the treaty ended in the smoke of that stately salutation, and the perpetual strife between the Dutch and English companies went on as bitterly as ever. In 1620 the Portuguese also attacked the English fleet under Captain Shillinge, but were defeated with great loss. From this time the estimation in which the Portuguese were held by the natives declined, while that of the English rose. In 1620, too, the English company established agencies at Agra and Patna.

The factory at Hoogly was established in 1640, and at Balasor in 1642. In 1645, in consequence of professional services rendered by Mr. Gabriel Boughton, surgeon of the *Hopewell*, to the Emperor Shah Jahan, additional privileges were granted to the company; and in 1646 the governor of Bengal, who had also been medically attended by Boughton, made concessions which placed the factories at Balasor and Hoogly on a more favourable footing. In 1661 Bombay was ceded to the British crown as part of the dower of Catharine of Braganza, but was not delivered up until 1665. King Charles II. transferred it to the East India Company, for an annual payment of £10, in 1668. The seat of the western presidency was removed to it from Surat in 1684–87. In 1687–88 the company's servants, broken in spirit by the oppressions of the native viceroy, determined to quit their factories in Bengal. In 1688 Captain Heath, of the *Resolution*, in command of the company's forces, embarked all its servants and goods, sailed down the Hoogly, and anchored off Balasor. They were, however, soon invited to return by the emperor, who granted them the site of the present city of Calcutta for a fortified factory. In 1689 the English factories at Vizagapatam and Masulipatam were seized by the Mohammedans, and the factors were massacred. But in the same year the company determined to consolidate their position in India on the basis of territorial sovereignty, to enable them to resist the oppression of the Moguls and Marhattas. With that view they passed the resolution which was destined to turn their clerks and factors throughout India into conquerors and proconsuls: "The increase of our revenue is the subject of our care as much as our trade; 'tis that must maintain our force when twenty accidents may interrupt our trade; 'tis that must make us a nation in India. Without that we are but a great number of interlopers, united by his Majesty's royal charter, fit only to trade where nobody of power thinks it their interest to prevent us. And upon this account it is that the wise Dutch, in all their general advices that we have seen, write ten paragraphs concerning their government, their civil and military policy, warfare, and the increase of their revenue, for one paragraph they write concerning trade."

A French East India Company was founded in 1604; a second in 1611; a third in 1615; a fourth (Richelieu's) in 1642; a fifth (Colbert's) in 1644. The sixth was formed by the union of the French East and West India, Senegal, and China companies under the name of The Company of the Indies, in 1719. The exclusive privileges of this company were, by the king's decree, suspended in 1769; and the company was finally abolished by the National Assembly in 1796.

The political history of the British in India begins in the eighteenth century with the French wars in the Karnatic. Fort St. George, the nucleus of Madras, founded by Francis Day in 1639, was the earliest British territorial possession, properly so called, in India. The French settlement of Pondicherri, about 100 miles lower down the Coromandel coast, was established in 1674; and for many years the English and French traded side by side without rivalry or territorial ambition. The English

appear to have been especially submissive to the native powers at Madras no less than in Bengal.

On the death of Aurungzebe in 1707, the whole of Southern India became practically independent of Delhi. In the Deccan Proper, the Nizam-ul-Mulk founded a hereditary dynasty, with Hyderabad for its capital, which exercised a nominal authority over the entire south. The Karnatic, or the lowland tract between the central plateau and the eastern sea, was ruled by a deputy of the Nizam. known as the Nawab of Arcot, who in his turn asserted claims to hereditary sovereignty. Further south, Trichinopoli was the capital of a Hindu rajah; Tanjore formed another Hindu kingdom under a degenerate descendant of Sivaji. Inland, Mysore was gradually growing into a third Hindu state; while everywhere local chieftains, called *palegars* or *naiks*, were in semi-independent possession of citadels or hill-forts. These represented the fief-holders of the ancient Hindu kingdom of Vijayanagar; and many of them had maintained a practical independence, subject to irregular payments and tribute, since its fall in 1565.

Such was the condition of affairs in Southern India when war broke out between the English and the French in Europe in 1744. Dupleix was at that time governor of Pondicherri, and Clive was a young writer at Madras. An English fleet first appeared on the Coromandel coast, but Dupleix by a judicious present induced the Nawab of Arcot to interpose and prevent hostilities. In 1746 a French squadron arrived, under the command of La Bourdonnais. Madras surrendered almost without a blow; and the only settlement left to the English was Fort St. David, a few miles south of Pondicherri, where Clive and a few other fugitives sought shelter. The nawab, faithful to his impartial policy, marched with 10,000 men to drive the French out of Madras, but was defeated. In 1748, an English fleet arrived under Admiral Boscawen, and attempted the siege of Pondicherri, while a land force cooperated under Major Lawrence, whose name afterwards became associated with that of Clive. The French repulsed all attacks; but the treaty of Aix-la-Chapelle, in the same year, restored Madras to the English.

The first war with the French was merely an incident in the greater contest in Europe. The second war had its origin in Indian politics while England and France were at peace. The easy success of the French arms had inspired Dupleix with the ambition of founding a French Empire in India under the shadow of the Mohammedan powers. Disputed successions at Hyderabad and at Arcot supplied his opportunity. On both thrones he placed nominees of his own, and for a short time posed as the arbiter of the entire south. In boldness of conception and in knowledge of Oriental diplomacy, Dupleix has had probably no rival. But he was no soldier, and he was destined in that sphere to encounter the "heaven-born genius" of Clive. The English of Madras, under the instinct of self-preservation, had maintained the cause of another candidate to the throne of Arcot in opposition to the nominee of Dupleix. Their candidate was Mohammed Ali, afterwards known in history as Wala-jah. The war which ensued between the French and English in Southern India has been exhaustively described by Orme. The one incident that stands out conspicuously is the capture and subsequent defence of Arcot by Clive in 1751. This heroic feat, even more than the battle of Plassey, spread the fame of English valour throughout India. Shortly afterwards Clive returned to England in ill-health, but the war continued fitfully for many years. On the whole English influence predominated in the Karnatic or Madras coast, and their candidate, Mohammed Ali, maintained his position at Arcot. But inland the French were supreme in the Deccan, and they were also able to seize the maritime tract called the Northern Circars.

The final struggle did not take place until 1760. In that year Colonel (afterwards Sir Eyre) Coote won the decisive victory of Wandewash over the French General Lally, and proceeded to invest Pondicherri, which was starved into capitulation in January, 1761. A few months later the hill-fortress of Ginjee (Gingi) also surrendered. In the words of Orme: "That day terminated the long hostilities between the two rival European powers in Coromandel, and left not a single ensign of the French nation avowed by the authority of its government in any part of India."

Meanwhile the narrative of British conquest shifts with Clive to Bengal. The first English settlement in that part of India was Pippli in Orissa, to which the East India Company was permitted to trade in 1634, five years before the foundation of Madras. The river on which Pippli stood has since silted up, and the very sight of the English settlement is now a matter of conjecture. In 1640 a factory was opened at Hoogly; in 1642, at Balasor; and in 1681 Bengal was erected into a separate presidency, though still subordinate to Madras. The name of Calcutta is not heard of till 1686, when Job Charnock, the chief at Hoogly, was expelled by the deputy of Aurungzebe, and settled lower down the river on the opposite bank. There he acquired a grant of the three petty villages of Sutanati, Gobindpur, and Kalighat (Calcutta), and founded the original Fort William in 1696.

At the time of Aurungzebe's death, in 1707, the Nawab or Governor of Bengal was Murshid Kuli Khan, known also in European history as Jafar Khan. By birth a Brahman, and brought up as a slave in Persia, he united the administrative ability of a Hindu to the fanaticism of a renegade. Hitherto the capital of Bengal had been at Dacca, on the eastern frontier of the empire, whence the piratical attacks of the Portuguese and of the Aracanese or Maghs could be most easily checked. Murshid Kuli Khan transferred his residence to Murshidabad, in the immediate neighbourhood of Kasimbazar, which was then the river port of the Gangetic trade. The English, the French, and the Dutch had each factories at Kasimbazar, as well as at Dacca, Patna, and Maldah. But Calcutta was the headquarters of the English, Chandarnagar of the French, and Chinsura of the Dutch; these three towns being situated close to one another in the lower reaches of the Hoogly, where the river was navigable for sea-going ships. Murshid Kuli Khan ruled over Bengal prosperously for twenty-one years, and left his power to a son-in-law and a grandson. The hereditary succession was broken in 1740 by Ali Vardi Khan, a usurper, but the last of the great Nawabs of Bengal. In his days the Marhatta horsemen began to ravage the country, and the inhabitants of Calcutta obtained permission in 1742 to erect an earthwork, known to the present day as the Marhatta ditch. Ali Vardi Khan died in 1756, and was succeeded by his grandson, Siraj-ud-Daula (Surajah Dowlah), a youth of only eighteen years, whose ungovernable temper led to a rupture with the English within two months after his accession. In pursuit of one of his own family who had escaped from his vengeance, he marched upon Calcutta with a large army. Many of the English fled down the river in their ships. The remainder surrendered after some resistance, and were thrust for the night into the "Black Hole" or military jail of Fort William, a room about 18 feet square, with only two small windows barred with iron. It was the English ordinary garrison prison in those times of cruel military discipline. But although the nawab does not seem to have been aware of the consequences, it meant death to a crowd of English men and women in the stifling heats of June. When the door of the prison was opened next morning, only 23 persons out of 146 remained alive.

The news of this disaster fortunately found Clive back again at Madras, where also was a squadron of the king's

ships under Admiral Watson. Clive and Watson promptly sailed to the mouth of the Ganges with all the troops they could get together. Calcutta was recovered with little fighting, and the nawab consented to a peace which restored to the company all their privileges, and gave them ample compensation for their losses. It is possible that matters might have ended thus, if a fresh cause of hostilities had not suddenly arisen. War had just been declared between the English and the French in Europe; and Clive, following the traditions of warfare in the Karnatic, captured the French settlement of Chandarnagar. Siraj-ud-Daula, exasperated by this breach of neutrality within his dominions, took the side of the French. But Clive, again acting upon the policy which he had learned from Dupleix, provided himself with a rival candidate (Mir Jafar) to the throne. Undaunted he marched out to the grove of Plassey, about 70 miles north of Calcutta, at the head of 1000 Europeans and 2000 sepoys, with eight pieces of artillery. The Bengal viceroy's army numbered 35,000 foot and 15,000 horse, with fifty cannon. Clive is said to have fought in spite of his council of war. The truth is, he could scarcely avoid a battle. The nawab attacked with his whole artillery at 6 A.M.; but Clive kept his men well under shelter, "lodged in a large grove, surrounded with good mud banks." At noon the enemy drew off into their entrenched camp for dinner. Clive only hoped to make a "successful attack at night." Meanwhile, the enemy being probably undressed over their cooking-pots, he sprang upon one of their advanced posts, which had given him trouble, and stormed "an angle of their camp." Several of the nawab's chief officers fell. The nawab himself, dismayed by the unexpected confusion, fled on a camel; his troops dispersed in a panic, and Clive found he had won a great victory. Mir Jafar's cavalry, which had hovered undecided during the battle, and had been repeatedly fired on by Clive to make them keep their distance, now joined the British camp, and the road to Murshidabad lay open.

The battle of Plassey was fought on 23rd June, 1757, and history agreed to adopt this date as the beginning of the British Empire in the East. But the immediate results of the victory were comparatively small, and several years passed in hard fighting before even the Bengalis would admit the superiority of the British arms. For the moment, however, all opposition was at an end. Clive, again following in the steps of Dupleix, placed Mir Jafar upon the viceregal throne at Murshidabad, being careful to obtain a patent of investiture from the Mogul court. Enormous sums were exacted from Mir Jafar as the price of his elevation. The company claimed 10,000,000 rupees as compensation for its losses, and other claims were preferred, amounting altogether to £2,700,000. The English still cherished extravagant ideas of Indian wealth. But no funds existed to satisfy their inordinate demands, and they had to be contented with one-half the stipulated sums. Even of this reduced amount, one-third had to be taken in jewels and plate, there being neither coin nor specie left.

At the same time, the nawab made a grant to the company of the *zamindari* or landholders' rights over an extensive tract of country round Calcutta, now known as the district of the twenty-four parganas. The area of this tract was 882 square miles. In 1757 the company obtained only the *zamindari* rights—*i.e.* the rights to collect the cultivators' rents, with the revenue jurisdiction attached. The superior lordship, or right to receive the land tax, remained with the nawab. But in 1759 this also was granted by the Delhi emperor, the nominal suzerain of the nawab, in favour of Clive, who thus became the landlord of his own masters, the company. Clive was enrolled among the nobility of the Mogul Empire, with the rank of commander of 6000 foot and 5000 horse, and a large allotment of land near Calcutta, 1759.

In 1758 Clive was appointed by the court of directors the first governor of all the company's settlements in Bengal. Two powers threatened hostilities. On the west, the Shahzada or imperial prince, known afterwards as the Emperor Shah Alam, with a mixed army of Afghans and Marhattas, and supported by the Nawab Wazir of Oudh, was advancing his own claims to the province of Bengal. In the south the influence of the French under Lally and Bussy was overshadowing the British at Madras. The name of Clive exercised a decisive effect in both directions. Mir Jafar was anxious to buy off the Shahzada, who had already invested Patna. But Clive marched in person to the rescue, with an army of only 450 Europeans and 2500 sepoys, and the Mogul army dispersed without striking a blow. In the same year Clive despatched a force southwards under Colonel Forde, which recaptured Masulipatam from the French, and permanently established British influence throughout the Northern Circars and at the court of Hyderabad. He next attacked the Dutch, the only other European nation who might yet prove a rival to the English. He defeated them both by land and water; and their settlement at Chinsura existed thenceforth only on sufferance.

From 1760 to 1765 Clive was in England. He had left no system of government in Bengal, but merely the tradition that unlimited sums of money might be extracted from the natives by the terror of the English name. In 1761 it was found expedient and profitable to dethrone Mir Jafar, the English Nawab of Murshidabad, and to substitute his son-in-law, Mir Kasim, in his place. On this occasion, besides private donations, the English received a grant of the three districts of Bardwan, Midnapur, and Chittagong, estimated to yield a net revenue of £500,000 sterling. But Mir Kasim soon began to show a will of his own, and to cherish dreams of independence. He proceeded to organize an army, drilled and equipped after European models, and to carry on intrigues with the Nawab Wazir of Oudh. He resolved to try his strength with the English, and found a good pretext. The company's servants claimed the privilege of carrying on their private trade throughout Bengal free from inland dues and all imposts. The assertion of this claim caused affrays between the customs officers of the nawab and the native traders, who, whether truly or not, represented that they were acting on behalf of the servants of the company. The nawab alleged that his civil authority was everywhere set at naught. The majority of the council at Calcutta would not listen to his complaints. The governor, Mr. Vansittart, and Warren Hastings, then a junior member of council, attempted to effect some compromise. But the controversy had become too hot. The nawab's officers fired upon an English boat, and forthwith all Bengal rose in arms. Two thousand of our sepoys were cut to pieces at Patna; about 200 Englishmen, who there and in other parts of the province fell into the hands of the Mohammedans, were massacred.

But as soon as regular warfare commenced Mir Kasim met with no more successes. His trained regiments were defeated in two pitched battles by Major Adams, at Gheriah and at Udha-nala; and he himself took refuge with the Nawab Wazir of Oudh, who refused to deliver him up. A more formidable danger appeared in the English camp in the form of the first sepoy mutiny. This was quelled by Major (afterwards Sir Hector) Munro, who ordered twenty-four of the ringleaders to be blown from guns, an old Mogul punishment. In 1764 Major Munro won the decisive battle of Baxar, which laid Oudh at the feet of the conquerors, and brought the Mogul emperor as a suppliant to the English camp.

Meanwhile the council at Calcutta had twice found the opportunity they loved of selling the government of Bengal to a new nawab. But in 1765 Clive (now Baron Clive of

Plassey in the peerage of Ireland) arrived at Calcutta as governor of Bengal for the second time. Two landmarks stand out in his policy. First, he sought the substance, although not the name, of territorial power, under the fiction of a grant from the Mogul emperor. Second, he desired to purify the company's service, by prohibiting illicit gains and guaranteeing a reasonable pay from honest sources. In neither respect were his plans carried out by his immediate successors. But the beginning of British Indian rule dates from this second governorship of Clive, as our military supremacy had dated from his victory at Plassey.

Clive landed, advanced rapidly up from Calcutta to Allahabad, and there settled in person the fate of nearly half of India. Oudh was given back to the Nawab Wazir, on condition of his paying £500,000 sterling towards the expenses of the war. The provinces of Allahabad and Kora, forming the greater part of the Doab, were handed over to Shah Alam himself, who in his turn granted to the company the *diwáni* or fiscal administration of Bengal, Behar, and Orissa, and also the territorial jurisdiction of the Northern Circars. A puppet nawab was still maintained at Murshidabad, who received an annual allowance from us of £600,000. Half that amount, or about £300,000, we paid to the emperor as tribute from Bengal. Thus was constituted the dual system of government, by which the English received all the revenues and undertook to maintain the army; while the criminal jurisdiction, or *nizámat*, was vested in the nawab. In Indian phraseology, the company was *diwán* and the nawab was *nizám*. The actual collection of the revenues still remained for some years in the hands of native officials.

Clive's other great task was the reorganization of the company's service. All the officers, civil and military alike, were tainted with the common corruption. Their legal salaries were paltry and quite insufficient for a livelihood. But they had been permitted to augment them, sometimes a hundredfold, by means of private trade and gifts from the native powers. Despite the united resistance of the civil servants, and an actual mutiny of 200 military officers, Clive carried through his reforms. Private trade and the receipt of presents were prohibited for the future, while a substantial increase of pay was provided out of the monopoly of salt.

Lord Clive quitted India for the third and last time in 1767. Between that date and the governorship of Warren Hastings in 1772, little of importance occurred in Bengal beyond the terrible famine of 1770, which is officially reported to have swept away one-third of the inhabitants. The dual system of government established in 1765 by Clive had proved a failure. Warren Hastings, a tried servant of the company, distinguished alike for intelligence, for probity, and for knowledge of Oriental manners, was nominated governor by the court of directors, with express instructions to carry out a predetermined series of reforms. In their own words, the court had resolved to "stand forth as *diwan*, and to take upon themselves, by the agency of their own servants, the entire care and administration of the revenues." In the execution of this plan Hastings removed the exchequer from Murshidabad to Calcutta, and appointed European officers, under the now familiar title of collectors, to superintend the revenue collections and preside in the courts.

Clive had laid the territorial foundations of the British Empire in Bengal. Hastings may be said to have created a British administration for that empire. The wars forced on him by native powers in India, the clamours of his masters in England for money, and the virulence of Francis with a faction of his colleagues at the council table in Calcutta, retarded the completion of his schemes. But the manuscript records disclose the patient statesmanship and indomitable industry which he brought to bear upon them. From 1765 to 1772 Clive's dual system of government, by corrupt native underlings and rapacious English chiefs, prevailed. Thirteen years were now spent by Warren Hastings in experimental efforts at rural administration by means of English officials (1772–85). The completion of the edifice was left to his successor. But Hastings was the administrative organizer, as Clive had been the territorial founder, of our Indian Empire.

Hastings rested his claims as an Indian ruler on his administrative work. He reorganized the Indian service, reformed every branch of the revenue collections, created courts of justice and some semblance of a police. But history remembers his name, not for his improvements in the internal administration, but for his bold foreign policy, and for the crimes into which it led him. From 1772 to 1774 he was governor of Bengal; from the latter date to 1785 he was the first governor-general of India, presiding over a council nominated, like himself, under a statute of Parliament known as the Regulating Act (1773). In his domestic policy he was greatly hampered by the opposition of his colleague in council, Philip Francis. But in his external relations with Oudh, with the Marhattas, and with Hyder Ali, he was generally able to compel assent to his views.

His relations with the native powers, like his domestic policy, formed a well-considered scheme. Hastings had to find money for the court of directors in England, whose thirst for the wealth of India was not less keen, although more decorous, than that of their servants in Bengal. He had also to protect the company's territory from the native powers, which, if he had not destroyed them, would have annihilated him. An honest man under such circumstances might be led into questionable measures. Hastings in his personal dealings, and as regards his personal gains, seems to have been a high-minded English gentleman. But as an Anglo-Indian statesman, he shared the laxity which he saw practised by the native potentates with whom he had to deal. Parts of his policy were vehemently assailed in Parliament, and cannot be upheld by right-thinking men. See Hastings, Warren.

In 1786 Hastings was succeeded by Lord Cornwallis, the first English nobleman of rank who undertook the office of governor-general of India. He twice held the high post of governor-general. His first rule lasted from 1786 to 1793, and is celebrated for two events—the introduction of the permanent settlement into Bengal, and the second Mysore War. If the foundations of the system of civil administration were laid by Hastings, the superstructure was raised by Cornwallis. It was he who first intrusted criminal jurisdiction to Europeans, and established the Nizamat Sadr Adalat, or Supreme Court of Criminal Judicature, at Calcutta; and it was he who separated the collector and judge.

The system thus organized in Bengal was afterwards extended to Madras and Bombay, when those presidencies also acquired territorial sovereignty. But the achievement most familiarly associated with the name of Cornwallis is the permanent settlement of the land revenue of Bengal. During four years, 1786–90, he laboured, with the help of an able Bengal civilian, John Shore, to arrive at the facts of the case. Warren Hastings had introduced, unsuccessfully and only for a period, a five years' settlement of the land revenue. Lord Cornwallis, after three years of inquiry and of provisional measures, introduced a ten years' or decennial settlement (1789–91). Up to this time the revenue had been collected pretty much according to the old Mogul system. The *zemindars*, or government farmers, whose office always tended to become hereditary, were recognized as having a right to collect the revenue from the actual cultivators. But no principle of assessment existed, and the amount actually realized varied greatly from year to year. Hastings seems to have looked

to experience, as acquired from a succession of quinquennial settlements, to furnish the standard rate of the future. Francis, on the other hand, Hastings' great rival, advocated a limitation of the state demand in perpetuity. The same view recommended itself to the authorities at home, partly because it would place their finances on a more stable basis, partly because it seemed to identify the zemindar with the landlord of the English system of property. Accordingly Cornwallis took out with him in 1787 instructions to introduce a permanent settlement.

The process of assessment began in 1789 and terminated in 1791. No attempt was made to measure the fields or calculate the outturn, as had been done by Akbar, and as is now done whenever settlements are made in the British provinces. The amount to be paid in the future was fixed by reference to what had been paid in the past. At first the settlement was called decennial, but in 1793 it was declared permanent for ever. The total assessment amounted to 26,800,989 Sikka rupees, or about £3,000,000 sterling for Bengal. Lord Cornwallis carried the scheme into execution, but the praise or blame, so far as details are concerned, belongs to Sir John Shore, afterwards Lord Teignmouth, a civil servant, whose knowledge of the country was unsurpassed in his time.

The second Mysore War, of 1790–92, is noteworthy on two accounts. Lord Cornwallis, the governor-general, led the British army in person, with a pomp and a magnificence of supply which recalled the campaigns of Aurungzebe. The two great southern powers, the Nizam of the Deccan and the Marhatta confederacy, co-operated as allies of the British. In the end Tippoo Sultan submitted when Lord Cornwallis had commenced to beleaguer his capital. He agreed to yield one-half of his dominions to be divided among the allies, and to pay £3,000,000 sterling towards the cost of the war. These conditions he fulfilled, but ever afterwards he burned to be revenged upon his English conquerors.

The period of Sir John Shore's rule as governor-general, from 1793 to 1798, was uneventful. In 1798 Lord Mornington, better known as the Marquis of Wellesley, arrived in India, already inspired with imperial projects which were destined to change the map of the country. Wellesley was the friend and favourite of Pitt, from whom he is thought to have derived his far-reaching political vision and his antipathy to the French name. From the first he laid down as his guiding principle that the English must be the one paramount power in the peninsula, and that native princes could only retain the insignia of sovereignty by surrendering their political independence. The history of India since his time has been but the gradual development of this policy, which received its finishing touch when Queen Victoria was proclaimed Empress of India on the 1st of January, 1877.

To frustrate the possibility of a French invasion of India, led by Napoleon in person, was the governing idea of Wellesley's foreign policy. France at this time, and for many years later, filled the place afterwards occupied by Russia in the imagination of English statesmen. Nor was the danger so remote as might now be thought. French regiments guarded and overawed the Nizam of Hyderabad. The soldiers of Sindhia, the military head of the Marhatta confederacy, were disciplined and led by French adventurers. Tippoo Sultan of Mysore carried on a secret correspondence with the French directorate, allowed a tree of liberty to be planted in his dominions, and enrolled himself in a republican club as Citizen Tippoo. The islands of Mauritius and Bourbon afforded a convenient half-way rendezvous for French intrigue and for the assembling of a hostile expedition. Above all, Napoleon Bonaparte was then in Egypt, dreaming of the conquests of Alexander; and no man knew in what direction he might turn his hitherto unconquered legions.

Wellesley conceived the scheme of crushing for ever the French hopes in Asia, by placing himself at the head of a great Indian confederacy. In Lower Bengal the conquests of Clive and the policy of Warren Hastings had made the English paramount. Before the end of the century the British power was consolidated from the sea-board to Benares, high up the Ganges valley. Beyond the British frontier there the Nawab Wazir of Oudh had agreed to pay a subsidy for the aid of British troops. This sum in 1797 amounted to £760,000 a year; and the nawab, being always in arrears, entered into negotiations for a cession of territory in lieu of a cash payment. In 1801 the treaty of Lucknow made over to the British the *Doab*, or fertile tract between the Ganges and the Jumna, together with Rohilkhand. In Southern India the British possessions were chiefly confined, before Lord Wellesley, to the coast districts of Madras and Bombay. Wellesley resolved to make the British supreme as far as Delhi in Northern India, and to compel the great powers of the south to enter into subordinate relations to the company's government. The intrigues of the native princes gave him his opportunity for carrying out this plan without breach of faith. The time had arrived when the English must either become supreme in India or be driven out of it. The Mogul Empire was completely broken up; and the sway had to pass either to the local Mohammedan governors of that empire, or to the Hindu confederacy represented by the Marhattas, or to the British. Lord Wellesley determined that it should pass to the British.

His work in Northern India was at first easy. The treaty of Lucknow in 1801 made us territorial rulers as far as the heart of the present North-western Provinces, and established our political influence in Oudh. Beyond those limits the northern branches of the Marhattas practically held sway, with the puppet emperor in their hands. Lord Wellesley left them untouched for a few years, until the second Marhatta War (1802–1804) gave him an opportunity for dealing effectively with their nation as a whole. In Southern India he saw that the Nizam at Hyderabad stood in need of his protection, and he converted him into a useful follower throughout the succeeding struggle. The other Mohammedan power of the south, Tippoo Sultan of Mysore, could not be so easily handled. Lord Wellesley resolved to crush him, and had ample provocation for so doing. The third power of Southern India —namely, the Marhatta confederacy—was so loosely organized that Lord Wellesley seems at first to have hoped to live on terms with it. When several years of fitful alliance had convinced him that he had to choose between the supremacy of the Marhattas or of the British in Southern India, he did not hesitate to decide.

Lord Wellesley first addressed himself to the weakest of the three southern powers, the Nizam at Hyderabad. Here he won a diplomatic success, which turned a possible rival into a subservient ally. The French battalions at Hyderabad were disbanded, and the Nizam bound himself by treaty not to take any European into his service without the consent of the English government—a clause since inserted in every engagement entered into with native powers.

Wellesley next turned the whole weight of his resources against Tippoo, whom Cornwallis had defeated, but not subdued. Tippoo's intrigues with the French were laid bare, and he was given an opportunity of adhering to the new subsidiary system. On his refusal war was declared, and Wellesley came down in viceregal state to Madras to organize the expedition in person, and to watch over the course of events. One English army marched into Mysore from Madras, accompanied by a contingent from the Nizam. Another advanced from the western coast. Tippoo, after a feeble resistance in the field, retired into Seringapatam, and when his capital was stormed, died fighting bravely in the

breach, 1799. Since the battle of Plassey no event so greatly impressed the native imagination as the capture of Seringapatam, which won for General Harris a peerage and for Wellesley an Irish marquisate. In dealing with the territories of Tippoo Wellesley acted with moderation. The central portion, forming the old state of Mysore, was restored to an infant representative of the Hindu rajahs whom Hyder Ali had dethroned; the rest of Tippoo's dominions was partitioned between the Nizam, the Marhattas, and the English. At about the same time the Karnatak, or the part of South-eastern India ruled by the Nawab of Arcot, and also the principality of Tanjore, were placed under direct British administration, thus constituting the Madras Presidency almost as it has existed to the present day. The sons of the slain Tippoo were treated by Lord Wellesley with paternal tenderness. They received a magnificent allowance, with semi-royal establishment, first at Vellore, and afterwards in Calcutta. The last of them, Prince Ghulam Mohammed, was long a familiar and public-spirited citizen of Calcutta, an active justice of the peace, and died as recently as 1877.

The Marhattas had been the nominal allies of the English in both their wars with Tippoo. But they had not rendered active assistance, nor were they secured to the English side as the Nizam now was. The Marhatta powers at this time were five in number. The recognized head of the confederacy was the Peshwa of Poona, who ruled the hill country of the Western Ghats, the cradle of the Marhatta race. The fertile province of Gujerat was annually harried by the horsemen of the Gaekwar of Baroda. In Central India two military leaders, Sindhia of Gwalior and Holkar of Indore, alternately held the pre-eminency. Towards the east the Bhonsla Rajah of Nagpur reigned from Berar to the coast of Orissa. Wellesley laboured to bring these several Marhatta powers within the net of his subsidiary system. In 1802 the necessities of the Peshwa, who had been defeated by Holkar and driven as a fugitive into British territory, induced him to sign the treaty of Bassein. By this he pledged himself to the British to hold communications with no other power, European or native, and granted to us districts for the maintenance of a subsidiary force. This greatly extended the English territorial influence in the Bombay Presidency. But it led to the second Marhatta War, as neither Sindhia nor the Rajah of Nagpur would tolerate the Peshwa's betrayal of the Marhatta independence.

The campaigns which followed are perhaps the most glorious in the history of the British arms in India. The general plan, and the adequate provision of resources, were due to the Marquis of Wellesley, as also the indomitable spirit which refused to admit of defeat. The armies were led by Sir Arthur Wellesley (afterwards Duke of Wellington) and General (afterwards Lord) Lake. Wellesley operated in the Deccan, where, in a few short months, he won the decisive victories of Assaye and Argaum, and captured Ahmednagar. Lake's campaign in Hindustan was no less brilliant, although it has received less notice from historians. He won pitched battles at Aligarh and Laswari, and took the cities of Delhi and Agra. He scattered the French troops of Sindhia, and at the same time stood forward as the champion of the Mogul emperor in his hereditary capital. Before the end of 1803 both Sindhia and the Bhonsla Rajah of Nagpur sued for peace. Sindhia ceded all claims to the territory north of the Jumna, and left the blind old emperor Shah Alam once more under British protection. The Bhonsla forfeited Orissa to the English, who had already occupied it with a flying column in 1803, and Berar to the Nizam, who gained a fresh addition by every act of complaisance to the British government. The freebooter Jaswant Rao Holkar alone remained in the field, supporting his troops by raids through Malwa and Rajputana. The concluding years of Wellesley's rule were occupied with a series of operations against Holkar, which brought little credit on the British name. The disastrous retreat of Colonel Monson through Central India (1804) recalled memories of the convention of Wargaum, and of the destruction of Colonel Baillie's force by Hyder Ali. The repulse of Lake in person at the siege of Bhartpur (Bhurtpore) is memorable as an instance of a British army in India having to turn back with its object unaccomplished (1805). Bhartpur was not finally taken till 1827.

Lord Wellesley, during his six years of office, carried out almost every part of his territorial scheme. In Northern India Lord Lake's campaigns, 1803–1805, brought the North-western Provinces (the ancient *Madhyadesa*) under British rule, together with the custody of the puppet emperor. The new districts were amalgamated with those previously acquired from the Nawab Wazir of Oudh into the "ceded and conquered provinces." This partition of Northern India remained till the Sikh wars of 1844 and 1847 gave the British the Punjab. In South-eastern India Lord Wellesley's conquests constituted the Madras presidency almost as it exists at this date. In South-western India the Peshwa was reduced to a vassal of the company. But the territories now under the governor of Bombay were not finally built up into their present form until the last Marhatta war in 1818.

The financial strain caused by these great operations of Lord Wellesley had meanwhile exhausted the patience of the court of directors at home. In 1805 Lord Cornwallis was sent out as governor-general a second time, with instructions to bring about peace at any price, while Holkar was still unsubdued and with Sindhia threatening a fresh war. But Cornwallis was now an old man, and broken down in health. Travelling up to the north-west during the rainy season, he sank and died at Ghazipur, before he had been ten weeks in the country. His immediate successor was Sir George Barlow, a civil servant of the company, who as a *locum tenens* had no alternative but to carry out the commands of his employers. Under these orders he curtailed the area of the British territory, and, in violation of engagements, abandoned the Rajput chiefs to the cruel mercies of Holkar and Sindhia. During his administration also occurred the mutiny of the Madras sepoys at Vellore (1806), which, although promptly suppressed, sent a shock of insecurity throughout the empire. The feebly economical policy of this interregnum proved a most disastrous one. But fortunately the rule soon passed into firmer hands.

Lord Minto, governor-general from 1807 to 1813, consolidated the conquests which Wellesley had acquired. His only military exploits were the occupation of the island of the Mauritius, and the conquest of Java by an expedition which he accompanied in person. The condition of Central India continued to be disturbed, but Lord Minto succeeded in preventing any violent outbreaks without himself having recourse to the sword. The company had ordered him to follow a policy of non-intervention, and he managed to obey his orders without injuring the prestige of the British name. Under his auspices the Indian government opened relations with a new set of foreign powers, by sending embassies to the Punjab, to Afghanistan, and to Persia. Metcalfe went as envoy to the Sikh court of Runjit Singh at Lahore, Elphinstone met the Shah of Afghanistan at Peshawur, and Malcolm was despatched to Persia. It cannot be said that these missions were fruitful of permanent results; but they introduced the English to a new set of diplomatic relations, and widened the sphere of their influence.

The successor of Lord Minto was the Earl of Moira, better known by his later title as the Marquis of Hastings. He completed Lord Wellesley's conquests in Central India, and left the Bombay presidency almost as it stands at

present. His long rule of nine years, from 1814 to 1823, was marked by two wars of the first magnitude, namely, the campaigns against the Gurkhas of Nepal, and the last Marhatta struggle.

The result of these wars was the annexation of a large tract of country to the Bombay Presidency, and the formation of the nucleus of the present Central Provinces. The map of India, as drawn by Lord Hastings, remained substantially unchanged until the time of Lord Dalhousie. But the proudest boast of Lord Hastings and Sir John Malcolm was, not that they had advanced the *pomarium*, but that they had conferred the blessings of peace and good government upon millions who had groaned under the extortions of the Marhattas and Pindaris.

The Marquis of Hastings was succeeded by Lord Amherst, whose administration lasted for five years, from 1823 to 1828. It is known in history by two prominent events, the first Burmese War and the capture of Bhartpur.

For some years the Burmese had made a series of encroachments upon the British districts. As they rejected all peaceful proposals with scorn, Lord Amherst was at last compelled to declare war in 1824. Little military glory could be gained by beating the Burmese, who were formidable chiefly from the pestilential character of their country. One expedition with gunboats proceeded up the Brahmaputra into Assam. Another marched by land through Chittagong into Aracan, for the Bengal sepoys refused to go by sea. A third, and the strongest, sailed from Madras direct to the mouth of the Irawaddi. The war was protracted over two years. After a loss to the British of about 20,000 lives, chiefly from disease, and an expenditure of £14,000,000, the King of Ava signed, in 1826, the treaty of Yandabu. By this he abandoned all claim to Assam, and ceded the Provinces of Aracan and Tenasserim, already in the military occupation of the British. He retained the whole valley of the Irawaddi, down to the sea at Rangoon.

The capture of Bhartpur in Central India by Lord Combermere, in January, 1827, wiped out the repulse which Lake had received before that city in January, 1805. A disputed succession led to the British intervention. Artillery could make little impression upon the massive walls of mud. But at last a breach was effected by mining, and the city was taken by storm, thus removing the popular notion throughout India that it was impregnable—a notion which had threatened to become a political danger.

The next governor-general was Lord William Bentinck, who had been governor of Madras twenty years earlier, at the time of the mutiny of Vellore (1806). His seven years' rule (from 1828 to 1835) is not signalized by any of those victories or extensions of territory by which chroniclers measure the growth of an empire. But it forms an epoch in administrative reform, and in the slow process by which a subject population is won over to venerate as well as to dread its alien rulers. The modern history of the British in India, as benevolent administrators, ruling the country with a single eye to the good of the natives, may be said to begin with Lord William Bentinck. According to the inscription upon his statue at Calcutta, from the pen of Macaulay:—"He abolished cruel rites, he effaced humiliating distinctions, he gave liberty to the expression of public opinion; his constant study was to elevate the intellectual and moral character of the nations committed to his charge." His first care on arrival in India was to restore equilibrium to the finances, which were tottering under the burden imposed upon them by the Burmese War. This he effected by three series of measures—first, by reductions in permanent expenditure, amounting to £1,500,000 sterling a year; second, by augmenting the revenue from land which had unfairly escaped assessment; third, by duties on the opium of Malwa. He also widened the gates by which educated natives could enter the service of the company. Some of these reforms were distasteful to the covenanted service and to the officers of the army. But Lord William was stanchly supported by the court of directors and by the ministry at home.

His most memorable acts are the abolition of *sati* (suttee), or widow-burning, and the suppression of the *thags* (thugs). At this distance of time it is difficult to realize the degree to which these two barbarous practices had corrupted the social system of the Hindus. European research has clearly proved that the text in the Vedas adduced to authorize the immolation of widows was a wilful mistranslation. But the practice had been enshrined in Hindu opinion by the authority of centuries, and had acquired the sanctity of a religious rite. The Emperor Akbar prohibited it, but failed to put it down. The early English rulers did not dare to violate the religious traditions of the people. In the year 1817, no less than 700 widows are said to have been burned alive in the Bengal Presidency alone. To this day the holy spots of Hindu pilgrimage are thickly dotted with little white pillars, each commemorating a *sati*. In spite of strenuous opposition, both from Europeans and natives, Lord William Bentinck carried a regulation in council on the 4th December, 1829, by which all who abetted *sati* were declared guilty of culpable homicide. The honour of suppressing *thagi* must be shared between Lord William Bentinck and Captain Sleeman. *Thags* were hereditary assassins, who made strangling their profession. They travelled in bands, disguised as merchants or pilgrims, and were sworn together by an oath based on the rites of the bloody goddess Kali. Between 1826 and 1835, as many as 1562 thags were apprehended in different parts of British India, and, by the evidence of approvers, this moral plague-spot was gradually stamped out.

Two other historical events are connected with the administration of Lord William Bentinck. In 1833 the charter of the East India Company was renewed for twenty years, but upon the conditions that the company should abandon its trade and permit Europeans to settle in the country. At the same time a fourth or legal member was added to the governor-general's council, who might not be a servant of the company; and a commission was appointed to revise and codify the law. Macaulay was the first legal member of council, and the first president of the law commission.

Sir Charles (afterwards Lord) Metcalfe succeeded Lord William as senior member of council. His short term of office is memorable for the measure which his predecessor had initiated, but which he carried into execution, for giving entire liberty to the press. Public opinion in India, as well as the express wish of the court of directors at home, pointed to Metcalfe as the fittest person to carry out the policy of Bentinck, not provisionally, but as governor-general for a full term. Party exigencies, however, led to the appointment of Lord Auckland. From this date commences a new era of war and conquest, which may be said to have lasted for twenty years. All looked peaceful until Lord Auckland, prompted by his evil genius, attempted to place Shah Soojah upon the throne of Cabul; an attempt conducted with gross mismanagement, and ending in the annihilation of the British garrison placed in that city. See AFGHANISTAN.

Lord Auckland had been superseded by Lord Ellenborough, and he in turn was recalled by the court of directors, who differed from him on points of administration, disliked his theatrical display, and distrusted his erratic genius. He was succeeded by Sir Henry (afterwards Lord) Hardinge, who had served through the Peninsular War and lost a hand at Ligny. It was felt on all sides that a trial of strength between the British and the only remaining Hindu power in India, the great Sikh nation, drew near.

The Sikhs were not a nationality like the Marhattas,

but a religious sect bound together by the additional tie of military discipline. They trace their origin to Nanak Shah, a pious Hindu reformer, born near Lahore in 1469, before the ascendency of either Moguls or Portuguese in India. Nanak, like other zealous preachers of his time, preached the abolition of caste, the unity of the godhead, and the obligation of leading a pure life. From Nanak, ten *gurus* or apostles are traced down to Govind Singh in 1708, with whom the succession stopped. Cruelly persecuted by the ruling Mohammedans, almost exterminated under the miserable successors of Aurungzebe, the Sikh martyrs clung to their faith with unflinching zeal. At last the downfall of the Mogul Empire transformed the sect into a territorial power. It was the only political organization remaining in the Punjab. The Sikhs in the north, and the Marhattas in Southern and Central India, thus became the two great Hindu powers who partitioned the Mogul Empire. Even before the rise of Runjit Singh, offshoots from the Sikh *misls* or confederacies, each led by its elected *sardar*, had carved out for themselves feudal principalities along the banks of the Sutlej, some of which endure to the present day. Runjit Singh, the founder of the Sikh kingdom, was born in 1780. In his twentieth year he obtained the appointment of governor of Lahore from the Afghan king, and formed the project of basing his personal rule upon the religious fanaticism of his Sikh countrymen. He organized the *khalsa*, or "the liberated," into an army under European officers, which for steadiness and religious fervour has had no parallel since the Ironsides of Cromwell. From Lahore, as his capital, he extended his conquests south to Multan, west to Peshawur, and north to Cashmere. On the east side alone he was hemmed in by the Sutlej, up to which river the authority of the British government had advanced in 1804. Till his death, in 1839, Runjit Singh was ever loyal to the engagements which he had entered into with Metcalfe in 1809. But he left no son capable of wielding his sceptre. Lahore was torn by dissensions between rival generals, ministers, and queens. The only strong power was the army of the *khalsa*, which, since the British disaster in Afghanistan, burned to measure its strength with the sepoys. The French or European generals, Avitabile and Court, were foolishly ousted, and the supreme military command was vested in a series of *panchayats* or elective committees of five.

In 1845 the Sikh army, numbering 60,000 men with 150 guns, crossed the Sutlej and invaded British territory. Sir Hugh Gough, the commander-in-chief, together with the governor-general, hurried up to the frontier. Within three weeks, four pitched battles were fought, at Mudki, Firozshah, Aliwal, and Sobraon. The British loss on each occasion was heavy; but by the last victory the Sikhs were fairly driven back over the Sutlej, and Lahore surrendered to the British. By the terms of peace then dictated, the infant son of Runjit, Dhulip Singh, was recognized as rajah; the Jalandhar Doab, or tract between the Sutlej and the Ravi, was annexed; the Sikh army was limited to a specified number; Major Henry Lawrence was appointed to be resident at Lahore; and a British force sent to garrison the Punjab for a period of eight years. Sir Henry Hardinge received a peerage, and returned to England in 1848.

Lord Dalhousie succeeded. The eight years' rule of this greatest of Indian proconsuls (1848–56) left more conspicuous results than that of any governor-general since Clive. A high-minded statesman, of a most sensitive conscience, and earnestly desiring peace, Lord Dalhousie found himself forced against his will to fight two wars and to embark on a policy of annexation. His campaigns in the Punjab and in Burma ended in large acquisitions of territory; while Nagpur, Oudh, and several minor states also came under British rule. But Dalhousie's deepest interest lay in the advancement of the moral and material condition of the country. The system of administration carried out in the conquered Punjab by the two Lawrences and their assistants is probably the most successful piece of difficult work ever accomplished by Englishmen. British Burma has prospered under our rule not less than the Punjab. In both cases, Lord Dalhousie himself laid the foundations of our administrative success, and deserves a large share of the credit. No branch of the administration escaped his reforming hand. He founded the public works department, with a view to creating the network of roads and canals which now cover India. He opened the Ganges Canal, still the largest work of the kind in the country; and he turned the sod of the first Indian railway. He promoted steam communication with England *via* the Red Sea, and introduced cheap postage and the electric telegraph. It is Lord Dalhousie's misfortune that these benefits are too often forgotten in the recollections of the mutiny, which followed his policy of annexation, after the firm hand which had remodelled British India was withdrawn.

Lord Dalhousie had not been six months in India before the second Sikh War broke out. Two British officers were treacherously assassinated at Multan. Unfortunately Henry Lawrence was at home on sick leave. The British army was not ready to act in the hot weather; and, despite the single-handed exertions of lieutenant (afterwards Sir Herbert) Edwardes, this outbreak of fanaticism led to a general rising. The *khalsa* army again came together, and once more fought on even terms with the British. On the fatal field of Chilianwala, which patriotism prefers to call a drawn battle, the British lost 2400 officers and men, besides four guns and the colours of three regiments (13th January, 1849). Before reinforcements could come out from England, bringing Sir Charles Napier as commander-in-chief, Lord Gough had restored his reputation by the crowning victory of Gujerat, which absolutely destroyed the Sikh army. Multan had previously fallen; and the Afghan horse under Dost Mohammed, who had forgotten their hereditary antipathy to the Sikhs in their greater hatred of the British name, were chased back with ignominy to their native hills. The Punjab, annexed by proclamation on the 29th March, 1849, became a British province—a virgin field for the administrative talents of Dalhousie and the two Lawrences. Maharajah Dhulip Singh received an allowance of £58,000 a year, and went to reside in England as a country gentleman. The second Burmese War, in 1852, arose out of the ill treatment of some European merchants at Rangoon, and the insults offered to the captain of a frigate who had been sent to remonstrate. The whole valley of the Irawaddi, from Rangoon to Prome, was occupied in a few months; and as the King of Ava refused to treat, it was annexed by proclamation on the 20th December, 1852, under the name of Pegu, to the provinces of Aracan and Tenasserim, which we had acquired in 1826.

Lord Dalhousie's dealings with the feudatory states of India revealed the whole nature of the man. That rulers only exist for the good of the ruled was his supreme axiom of government, of which he gave a conspicuous example in his own daily life. That British administration was better for the people than native rule followed from this axiom. He was thus led to regard native chiefs from somewhat the same point of view as the Scotch regarded the hereditary jurisdictions after 1745, namely, as mischievous anomalies, to be abolished by every fair means. Good faith must be kept with rulers on the throne, and with their legitimate heirs. But no false sentiment should preserve dynasties which had forfeited our sympathies by generations of misrule, nor prolong those that had no natural successor. The doctrine of lapse was the practical application of these principles, complicated by the Indian

practice of adoption. It has never been doubted that, according to Hindu private law, an adopted son entirely fills the place of a natural son, whether to perform the religious obsequies of his father or to inherit his property. In all respects he continues the *persona* of the deceased. But it was argued that, both as a matter of historical fact and as one of political expediency, the succession to a throne stood upon a different footing. The paramount power could not recognize such a right, which might be used as a fraud to hand over the happiness of millions to a base-born impostor. Here came in Lord Dalhousie's maxim of the good of the governed. In his mind benefits to be conferred through British administration weighed heavier than a superstitious and often fraudulent fiction of inheritance.

The first state to escheat to the British government in accordance with these principles was Satara, which had been reconstituted by Lord Hastings on the downfall of the Peshwa in 1818. The Rajah of Satara, the last direct representative of Sivaji, died without a male heir in 1848, and his deathbed adoption was set aside (1849). In the same year the Rajput state of Karauli was saved by the court of directors, who drew a fine distinction between a dependent principality and a protected ally. In 1853, Jhansi suffered the same fate as Satara. But the most conspicuous application of the doctrine of lapse was the case of Nagpur. The last of the Marhatta Bhonslas, a dynasty older than the British government itself, died without a son, natural or adopted, in 1853. His territories were annexed, and became the Central Provinces. That year also saw British administration extended to the Berars, or the Assigned Districts, which the Nizam of Hyderabad was induced to hand over as a territorial guarantee for the subsidies which he perpetually kept in arrear. The relics of three other dynasties also passed away in 1853, though without any attendant accretion to British territory. In the extreme south, the titular Nawab of the Karnatic and the titular Rajah of Tanjore both died without heirs. Their rank and their pensions died with them, though compassionate allowances were continued to their families. In the north of India, Baji Rao, the ex-Peshwa who had been dethroned in 1818, lived on till 1853 in the enjoyment of his annual pension of £80,000. His adopted son, Nana Sahib, inherited his accumulated savings, but could obtain no further recognition.

Lord Dalhousie annexed the Province of Oudh on different grounds. Ever since the Nawab Wazir, Shuja-ud-Daula, received back his forfeited territories from the hands of Lord Clive in 1765, the existence of his dynasty had depended on the protection of British bayonets. Guarded alike from foreign invasion and from domestic rebellion, the long line of nawabs had sunk into private debauchees and public oppressors. Their one virtue was steady loyalty to the British government. The fertile districts between the Ganges and the Gogra, which now support a denser population than any rural area of the same size on the globe, had been groaning for generations under an anarchy for which each British governor-general felt himself in part responsible. Warning after warning had been given to the nawabs (who had assumed the title of shah or king since 1819) that they must put their house in order. What the benevolent Bentinck and the soldierly Hardinge had only threatened, was reserved for Lord Dalhousie, who united honesty of purpose with stern decision of character, to perform. He laid the whole case before the court of directors, who, after long and painful hesitation, resolved on annexation. Lord Dalhousie, then on the eve of retiring, felt that it would be unfair to leave the perilous task to his successor in the first moments of his rule. The tardy decision of the court of directors left him, however, only a few weeks to carry out the work. But he solemnly believed that work to be his duty to the people of Oudh. "With this feeling on my mind," he wrote privately, "and in humble reliance on the blessing of the Almighty (for millions of his creatures will draw freedom and happiness from the change), I approach the execution of this duty, gravely and not without solicitude, but calmly and altogether without doubt."

At the commencement of 1856, the last year of his rule, he issued orders to General (afterwards Sir James) Outram, then resident at the court of Lucknow, to assume the direct administration of Oudh, on the ground that the British government would be guilty in the sight of God and man if it were any longer to aid in sustaining by its countenance an administration fraught with suffering to millions. The proclamation was issued on the 13th February, 1856. The king, Wajid Ali, bowed to irresistible force, although he refused to recognize the justice of his deposition. After a mission to England, by way of protest and appeal, he settled down in the pleasant suburb of Garden Reach near Calcutta, in the enjoyment of a pension of £120,000 a year. Oudh was thus annexed without a blow. But this measure, on which Lord Dalhousie looked back with the proudest sense of rectitude, was perhaps the one act of his rule that most alarmed native public opinion.

The Marquis of Dalhousie resigned office in March, 1856, being then only forty-four years of age; but he carried home with him the seeds of a lingering illness, which resulted in his death in 1860. Excepting Cornwallis, he was the first, though by no means the last, of English statesmen who have fallen victims to their devotion to India's needs. Lord Dalhousie completed the fabric of British rule in India. The empire as mapped out by Lord Wellesley and Lord Hastings, during the first quarter of the century, had received the addition of Sind in 1843. The Marquis of Dalhousie finally filled in the wide spaces covered by Oudh, the Central Provinces, and smaller states within India, together with the great outlying territories of the Punjab on the north-western frontier, and the richest part of British Burma beyond the sea.

The great governor-general was succeeded by his friend Lord Canning, who, at the farewell banquet in England given to him by the court of directors, uttered these prophetic words, "I wish for a peaceful term of office. But I cannot forget that in the sky of India, serene as it is, a small cloud may arise, no larger than a man's hand, but which, growing larger and larger, may at last threaten to burst and overwhelm us with ruin." In the following year the Sepoys of the Bengal army mutinied, and all the valley of the Ganges from Patna to Delhi rose in rebellion.

The various motives assigned for the mutiny appear inadequate to the European mind. The truth seems to be that native opinion throughout India was in a ferment, predisposing men to believe the wildest stories, and to rush into action in a paroxysm of terror. Panic acts on an Oriental population like drink among a European mob. The annexation policy of Lord Dalhousie, although dictated by the most enlightened considerations, was distasteful to the native mind. The spread of education, the appearance of the steam engine and the telegraph wire, seemed at the same moment to reveal a deep plan to substitute an English for an Indian civilization. The Bengal Sepoys, especially, thought that they could see further than the rest of their countrymen. Most of them were Hindus of high caste; many of them were recruited from Oudh. They regarded our reforms on Western lines as attacks on their own nationality, and they knew at first hand what annexation meant. They believed it was by their prowess that the Punjab had been conquered and that all India was held. The numerous dethroned princes, or their heirs and widows, were the first to learn and to take advantage of this spirit of disaffection and panic. They had heard of

the Crimean War, and were told that Russia was the perpetual enemy of England. Our munificent pensions had supplied the funds with which they could buy the aid of skilful intriguers. They had much to gain and little to lose by a revolution.

In this critical state of affairs, of which the government had no official knowledge, a rumour ran through the cantonments that the cartridges of the Bengal army had been greased with the fat of pigs—animals unclean alike to Hindu and Mohammedan. No assurances could quiet the minds of the Sepoys. Fires occurred nightly in the native lines; officers were insulted by their men; confidence was gone, and only the form of discipline remained.

The outbreak of the storm found the native regiments denuded of many of their best officers. The administration of the great empire, to which Dalhousie put the corner-stone, required a larger staff than the civil service could supply. The practice of selecting able military men for civil posts, which had long existed, received a sudden and vast development. Oudh, the Punjab, the Central Provinces, British Burma, were administered to a large extent by picked officers from the company's regiments. Good and skilful commanders remained; but the native army had nevertheless been drained of many of its brightest intellects and firmest wills at the very crisis of its fate.

On the afternoon of Sunday, 10th May, 1857, the Sepoys at Meerut (Mirath) broke into open mutiny. They burst into the jail, and rushed in a wild torrent through the cantonments, cutting down every European whom they met. They then streamed off to the neighbouring city of Delhi, to stir up the native garrison and the criminal population of that great city, and to place themselves under the authority of the discrowned Mogul emperor. Meerut was the largest military station in Northern India, with a strong European garrison of foot, horse, and guns, sufficient to overwhelm the mutineers before ever they reached Delhi. But as the Sepoys acted in irrational haste, so the British officers, in but too many cases, acted with equally irrational indecision. The news of the outbreak was telegraphed to Delhi, and nothing more was done that night. At the moment when one strong will might have saved India, no soldier in authority at Meerut seemed able to think or act. The next morning the Mohammedans of Delhi rose, and all that the Europeans there could do was to blow up the magazine. See DELHI.

A rallying centre and a traditional name were thus given to the revolt, which forthwith spread like wildfire through the north-western provinces and Oudh down into Lower Bengal. The same narrative must suffice for all the outbreaks, although each episode has its own story of sadness and devotion. The Sepoys rose on their officers, usually without warning, sometimes after protestations of fidelity. The Europeans, or persons of Christian faith, were massacred, occasionally, also, the women and children. The jail was broken open, the treasury plundered, and the mutineers marched off to some centre of revolt, to join in what had now become a national war. Only in the Punjab were the Sepoys anticipated by stern measures of repression and disarmament, carried out by Sir John Lawrence and his lieutenants, among whom Edwardes and Nicholson stand conspicuous. The Sikh population never wavered. Crowds of willing recruits came down from the Afghan hills. And thus the Punjab, instead of being itself a source of danger, was able to furnish a portion of its own garrison for the siege of Delhi. In Lower Bengal most of the Sepoys mutinied, and then dispersed in different directions. The native armies of Madras and Bombay remained true to their colours. In Central India the contingents of many of the great chiefs sooner or later joined the rebels, but the Mohammedan state of Hyderabad was kept loyal by the authority of its able minister, Sir Salar Jang.

The main interest of the Sepoy War gathers round the three cities of CAWNPORE, LUCKNOW, and DELHI. The cantonment at Cawnpore contained one of the three great native garrisons of India. At Bithur, not far off, was the palace of Dundhu Panth, the heir of the last Peshwa, who had inherited his savings, but failed to procure a continuance of his pension, and whose more familiar name of Nana Sahib will ever be handed down to infamy. At first the Nana was profuse in his professions of loyalty, but when the Sepoys mutinied on the 6th June, he put himself at their head, and was proclaimed Peshwa of the Marhattas. The Europeans at Cawnpore, numbering more women and children than fighting men, shut themselves up in an ill-chosen hasty entrenchment, where they heroically bore a siege for nineteen days under the sun of a tropical June. Every one had courage and endurance to suffer or to die; but the directing mind was again absent. On the 27th June, trusting to a safe-conduct from the Nana as far as Allahabad, they surrendered, and to the number of 450 embarked in boats on the Ganges. Forthwith a murderous fire was opened upon them from the river bank. Only a single boat escaped, and but four men, who swam across to the protection of a friendly rajah, ultimately survived to tell the tale. The rest of the men were massacred on the spot. The women and children, numbering 125, were reserved for the same fate on the 15th July, when the avenging army of Havelock was at hand.

Sir Henry Lawrence, the chief commissioner of Oudh, had foreseen the storm. He fortified and provisioned the Residency at Lucknow, and thither he retired with all the European inhabitants and a weak British regiment on 2nd July. Two days later he was mortally wounded by a shell. But the clear head was here in authority. Lawrence had deliberately chosen his position, and the little garrison held out under unparalleled hardships and against enormous odds, until relieved by Havelock and Outram on 25th September. But the relieving force was itself invested by fresh swarms of rebels; and it was not till November that Sir Colin Campbell (afterwards Lord Clyde) cut his way into Lucknow, and effected the final deliverance of the garrison, 16th November, 1857. Our troops then withdrew to more urgent work, and did not finally reoccupy Lucknow till March, 1858.

The siege of Delhi began on 8th of June, just one month after the original outbreak at Meerut. Siege in the proper sense of the word it was not; for the British army, encamped on the historic "ridge," never exceeded 8000 men, while the rebels within the walls were more than 30,000 strong. In the middle of August, Nicholson arrived with a reinforcement from the Punjab; but his own inspiring presence was even more valuable than the reinforcement he brought. On 14th September the assault was delivered, and after six days' desperate fighting in the streets, Delhi was again won. Nicholson fell at the head of the storming party. Hodson, the intrepid leader of a corps of irregular horse, hunted down next day the old Mogul emperor, Bahadur Shah, and his sons. The emperor was afterwards sent a state prisoner to Rangoon, where he lived till 1862. As the mob pressed in on the guard around the emperor's sons, near Delhi, Hodson found it necessary to shoot down the princes (who had been captured unconditionally) with his own hand.

After the fall of Delhi and the final relief of Lucknow, the war loses its dramatic interest, although fighting went on in various parts of the country for eighteen months longer. The population of Oudh and Rohilkhand, stimulated by the presence of the Begam of Oudh, the Nawab of Bareilly, and Nana Sahib himself, had joined the mutinous Sepoys *en masse*. In this quarter of India alone it was the revolt of a people rather than the mutiny of an army that had to be quelled. Sir Colin Campbell conducted the campaign in Oudh, which lasted through two cold seasons. Valuable assistance was lent by

Sir Jang Bahadur of Nepal, at the head of his gallant Gurkhas. Town after town was occupied, fort after fort was stormed, until the last gun had been recaptured, and the last fugitive had been chased across the frontier by January, 1859. In the meantime, Sir Hugh Rose (afterwards Lord Strathnairn), with another army from Bombay, was conducting an equally brilliant campaign in Central India. His most formidable antagonists were the disinherited Rani or Princess of Jhansi, and Tantia Topi, whose military talent had previously inspired Nana Sahib with all the capacity for resistance that he ever displayed. The princess died fighting bravely at the head of her troops in June, 1858. Tantia Topi, after doubling backwards and forwards through Central India, was at last betrayed and run down in April, 1859.

The company's charter had been granted from time to time for periods of twenty years, and each renewal formed an opportunity for a national inquest into the management of India. The parliamentary inquiry of 1813 abolished the company's monopoly of Indian trade, and compelled it to direct its energies in India to the good government of the people. The Charter Act of 1833 did away with its remaining Chinese trade, and opened up the government of India to the natives, irrespective of caste, creed, or race. The Act of 1853 abolished the patronage by which the company filled up the higher branches of its civil service, laid down the principle that the administration of India was too national a concern to be left to the chances of benevolent nepotism, and that England's representatives in India must be chosen openly, and without favour, from the youth of England. The mutiny sealed the fate of the East India Company, after an existence of more than two and a half centuries. See East India Company.

The Act for the better government of India (1858), which finally transferred the entire administration from the company to the crown, was not passed without an eloquent protest from the directors, nor without acrimonious party discussion in Parliament. It enacts that India shall be governed by, and in the name of, the Queen of England through one of her principal secretaries of state, assisted by a council of fifteen members. The governor-general received the new title of viceroy. The European troops of the company, numbering about 24,000 officers and men, were amalgamated with the royal service, and the Indian navy was abolished. By the Indian Councils Act (1861) the governor-general's council, and also the councils at Madras and Bombay, were augmented by the addition of non-official members, either natives or Europeans, for legislative purposes only; and by another Act passed in the same year high courts of judicature were constituted out of the old supreme courts at the Presidency towns.

It fell to the lot of Lord Canning both to suppress the mutiny and to introduce the peaceful revolution which followed. It suffices to say that he preserved his equanimity unruffled in the darkest hours of peril, and that the strict impartiality of his conduct incurred alternate praise and blame from partisans of both sides. The epithet then scornfully applied to him of "Clemency" Canning is now remembered only to his honour. On 1st November, 1858, at a grand *darbar* held at Allahabad, he sent forth the royal proclamation which announced that the queen had assumed the government of India. This document, which is, in the truest and noblest sense, the Magna Carta of the Indian people, proclaimed in eloquent words the policy of justice and religious toleration; and granted an amnesty to all except those who had directly taken part in the murder of British subjects. Peace was proclaimed throughout India on the 8th July, 1859. In the following cold weather Lord Canning made a viceregal progress through the northern provinces to receive the homage of loyal princes and chiefs, and to guarantee them the right of adoption. The Prince of Wales made a tour through the country in the cold weather of 1875–76. The presence of his royal highness evoked a passionate burst of loyalty never before known in the annals of British India. The feudatory chiefs and ruling houses of India felt for the first time that they were incorporated into the empire of an ancient and a splendid dynasty. On 1st January, 1877, Queen Victoria was proclaimed Empress of India at a *darbar* of unparalleled magnificence, held on the historic ridge overlooking the ancient Mogul capital, Delhi.

The changes effected in India under British rule have been little less than marvellous. Until their arrival vast districts were often depopulated and innumerable homesteads ravaged; thugs and robbers made all travelling unsafe; widow-burning, infanticide, and human sacrifices were common; no man's life and property could be called his own; the whole country was hastening to anarchy, chaos, and ruin. Under British administration order has been substituted for chaos, good government for anarchy, justice for oppression, a watchful police for plunderers and murderers, a well-organized army for unruly bands of soldiers, peace and security for war and rapine, well-drained land for feverish swamps, cultivated fields for wild jungle comfortable cottages for lairs of wild beasts, engineering works of greater magnitude than can be seen in any other part of the world, 11,000 miles of railway connecting every province; districts once shut up within themselves and hostile to each other brought into interconnection; tramways running in large towns; post offices and telegraphs in nearly every village; caste—the bane of progress—giving way before facilities of communication; laborious trigonometrical, topographical, industrial, and archæological surveys extended to every district; trade and commerce developing; old industries reviving, new ones being introduced; continually increasing plantations of tea, tobacco, indigo, and cinchona; new jute factories, cotton mills, paper mills being erected, new coal mines being opened, new hospitals, sanatoriums, orphanages, and admirably-arranged jails; education everywhere gaining ground; European literature and philosophies more and more appreciated; a free press giving birth to an increasing progeny of ably-conducted newspapers, magazines, and native books; municipal institutions and self-government gradually advancing; the whole tone of native thought and feeling being elevated and Christianized, if not converted to Christianity. Great Britain may well be proud of the work done by her sons, often in an exhausting climate and under many difficulties and drawbacks.

(We are indebted for much information in the preceding article to the admirable article on India by Dr. Hunter, Director-General of Statistics to the Government of India, in the "Imperial Gazetteer of India," published under the authority of the Indian government. Dr. Hunter has done more than any other writer to give accurate and important information on Indian subjects.)

INDIA PAPER, a very fine soft paper, of a yellowish tone, used for proof impressions of engravings. Originally it either came, or was believed to have come, from India. It has long been made in England. Lately a paper of Japanese manufacture has been frequently used for this purpose.

INDIA-RUBBER, or **CAOUTCHOUC,** is the milky juice of various trees and shrubs, which coagulates on drying, or on the addition of an acid or a salt solution, and possesses the property of elasticity. These plants belong chiefly to the Moreæ and Artocarpeæ tribes of the order Urticaceæ, and to the orders Apocynaceæ and Euphorbiaceæ. The milky juice is contained in the exceedingly narrow, branching tubes, known to botanists as laticiferous vessels, which in the Urticaceæ run, as a rule, through the bark close to the fibro-vascular bundles, but also, in Ficus, through the pith. These vessels in the Euphorbiaceæ are distributed through the whole thickness

of the stem from the pith to the bark, but are most abundantly developed close to the bast fibre bundles, occasionally entirely replacing them. In the Apocynaceæ the laticiferous vessels are even more constantly associated with the bast bundles. The situation of these vessels is of great importance, for it is only when they lie outside the cambium (the layer between the bark and the wood) that they can be tapped without injuring the cambium and so destroying the tree. The milkiness is due to the presence in the sap of caoutchouc in the form of globules so minute that 12,250 of them, placed in a straight line, would only measure an inch.

The first mention of india-rubber is in the "Historia" of Herrara, where, in speaking of the second voyage of Columbus, he mentions that the natives of Hayti played a game with balls made from the gum of a tree. Jean Torquemada is the first to describe a tree that yields the gum. In his work "Monarquia Indiana," published in 1615, he states that this tree is found in Mexico, and that it was called by the natives Ulequahil. After a general description of the tree, he proceeds to explain the method of procuring the juice, the characteristics of the gum itself (called by the Indians *ulli*), and finally the uses to which the gum was applied, among others for making boots and for rendering articles of apparel waterproof. No other notice of the juice occurs until 1736, when La Condamine described to the French Academy of Sciences his voyage to the equator, and with special reference to Peru drew attention to a gummy material obtained by the natives of that locality by incision from certain kinds of forest trees, called by them *caout-chou*, which was used by them for a variety of useful and ornamental purposes. Macquer was the first who dissolved caoutchouc in ether, and constructed small tubes by the evaporation of the solution on moulds of the required form. Dr. Priestley, in "A Familiar Introduction to the Theory and Practice of Perspective," published in 1770, calls attention to "a substance excellently adapted to the purpose of wiping from paper the marks of a blacklead pencil. . . . It is sold by Mr. Nairne, a mathematical instrument maker, opposite the Royal Exchange. He sells a cubical piece of about half an inch for 3*s*., and he says it will last several years." Hancock first invented a masticator to enable scrap rubber to be compounded into solid homogeneous masses. The invention of vulcanization by Goodyear in America, and by Hancock in England, gave an immense impetus to the india-rubber industry. Hancock's patent was obtained in 1843.

India-rubber is collected in much the same way as gutta-percha. The trees are tapped during the colder seasons of the year by making incisions in the bark round the trunk. The older the tree and the higher the incision, the greater is the amount of juice which flows. The modes of collection and treatment vary with the locality. In the original bottle india-rubber, in which form the first specimens of the material appeared in commerce in this country, the sap as it exuded was collected in suitable vessels, and moulds of clay were then plunged into the liquid, removed, exposed for a short time to the heat and smoke of a fire to coagulate the layer of juice, redipped and resmoked until the thickness was reached of half an inch or more. The whole was then plunged into water, and the clay softened and squeezed out, leaving a hollow flask of comparatively pure india-rubber. A second quality, called "nigger's-heads," was obtained by first procuring a comparatively thin coating of the gum on a clay mould in the way previously described, removing the clay mould, and then filling the bottles with more liquid, which was then coagulated.

The chemical constitution of india-rubber is the same as that of gutta, the hydrocarbon of gutta-percha. The percentage composition is—carbon, 87·5; hydrogen, 12·5. India-rubber is insoluble in water, and is not acted on by alkalies, alcohol, or dilute acids. It is soluble in coal-tar naphtha, turpentine, carbon disulphide, ether, benzol, and the fatty and volatile oils.

The most singular property of india-rubber is the change which it experiences when exposed to the action of sulphur at a high temperature, now known as vulcanization or curing. While the untreated rubber becomes supple and comparatively useless on exposure to a moderate degree of heat, and hard and inflexible under the influence of cold, the vulcanized material retains all its properties unaffected under either of the conditions named. The elasticity of the rubber is at the same time very greatly increased, its porosity diminished, and it becomes unaffected by the solvents which attack the unvulcanized material. It also remains unaffected by grease and fatty oils, which render ordinary rubber supple and useless. The surface vulcanization adopted in the treatment of Mackintosh goods entirely prevents softening on exposure to the sun. When the treatment of rubber is carried considerably beyond the degree of heat, duration of heating, and quantity of sulphur used in producing the ordinary elastic vulcanized material, a totally different substance is produced, termed vulcanite or ebonite. This material is generally black in colour, hard, of limited flexibility, and of about the consistence of

Hevea guianensis.

horn. It is one of the best insulators of electricity, and its property of becoming powerfully negatively electric by friction has led to its utilization for the plates of electric machines. It resists the action of solvents even more obstinately than the ordinary vulcanized material, scarcely even swelling when immersed in carbon disulphide.

Waterproof materials generally consist of thin cloth or canvas covered with a solution of india-rubber. They are composed either of a single layer of cloth, or of two layers with the rubber between them. The double fabric is that commonly called Mackintosh, from the name of its inventor, who took out a patent in 1823. The single fabric goods were patented by Hancock in 1837. The solvent employed at the present time for the rubber is coal-tar naphtha. The thin paste thus produced is placed on the stuff to be covered just at the moment that it is passing between two rollers, and the solvent is expelled by passing

the cloth along over a sheet-iron table heated by steam. In Mackintosh two pieces of cloth prepared in this way are passed, with their coated surfaces together, through rollers.

Para rubber is the most important of the various kinds. It is obtained in French Guiana from a tree called by botanists *Hevea guianensis* (see cut), which was formerly known as *Siphonia elastica.* In Venezuela it is procured from *Hevea brasiliensis*, which is like the former species, but its leaves are lanceolate instead of obovate. In British Guiana the source is *Hevea paucifolia.* Ceara rubber is derived from *Manihot glaziovii*, a native of the province of Rio Janeiro, and belonging, with the species of Hevea, to the order Euphorbiaceæ. Most of the rubber imported from Central America is the product of *Castilloa elastica.*

Ficus elastica.

Assam and Java rubbers are obtained from the well-known india-rubber plant, *Ficus elastica* (see cut), commonly cultivated in this country as an ornamental house-plant. Gambia and Sierra Leone rubbers are derived from species of Landolphia.

INDIAN ARCHITECTURE (*artha-sastra*), although ranked by the ancient Hindus as an *upa-veda* or supplementary part of inspired learning, owes its development to Buddhist rather than to Brahmanical impulses. A brick altar sufficed for the Vedic ritual. The Buddhists were the great stone-builders of India. Their monasteries and shrines exhibit the history of the art during twenty-two centuries, from the earliest cave structures and rock-temples to the latest Jain erections, dazzling in stucco and overcrowded with ornament. It seems not improbable that the churches of Europe owe their steeples to the Buddhist topes. The Greco-Bactrian kingdom profoundly influenced architecture and sculpture in Northern India; and a still greater change occurred later on, when the Mussulman conquerors brought in new forms and requirements of their own. Nevertheless, Hindu art powerfully modified the Moorish character of the imperial works of the Mongols, and has left behind memorials which extort the admiration and astonishment of our age. The Hindu builders, on their side, derived from the Mohammedans a lightness of structure which they did not formerly possess, while they added a very distinctive variation by retaining their native wealth of ornament and fanciful outlines. The palace architecture of Gwalior, the mosques and mausoleums of Agra and Delhi, with several of the older temples of Southern India, stand unrivalled for grace of outline and elaborate wealth of ornament. The Taj-Mahal [see AGRA] justifies Heber's exclamation, that its builders had designed like Titans and finished like jewellers. The open-carved marble windows and screens at Ahmedabad, &c., supply examples of the skilful ornamentation which beautifies every Indian building from the cave monasteries of the Buddhist period downward. The dome of the Mohammedan tomb at Bijapur is larger than that of the Pantheon at Rome, and the lovely Kutub tower at Delhi is not unworthy to be compared with Giotto's campanile at Florence. The mosque of Shah Jehan at Delhi is a town in itself. But these splendid structures of the Mohammedans in India really form a branch, and a very distinctive branch, of Moorish architecture; for the plan and the arrangement of the buildings, the dome, the court, the minaret, the stilted horse-shoe arches, &c., are Moorish, the workmanship and details alone are Hindu.

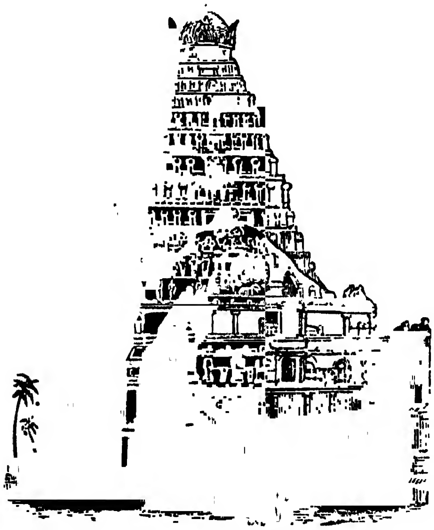
True Hindu architecture divides itself sharply into two parts—the excavated and the constructed. Of the curious excavated works, so strongly reminding us of similar Egyptian temples, and whose antiquity, at the most moderate computation, extends to several centuries before the Christian era, the most remarkable are those on the island of Elephanta, near Bombay; at Kennery in that of Salsette; those at Ellora, near Dowletabad; and those at Carlee, not far from Poonah. Many of those excavations are of prodigious extent, being composed of a series of apartments and recesses cut out of the rock, amounting in some instances to an almost incredible number. While colossal statues and sculptures display themselves within these cavern-temples and on their walls, elaborate embellishments of detail are frequently given to the columns, which appear capriciously put together, it being impossible to determine where their pedestals terminate and their shafts commence, or how much of the shafts belongs to the capitals. In this respect the Hindu style, at least this earliest class of it, differs materially from that of the Egyptians, where the shafts have no pedestals and scarcely anything like a distinct base, but where the capital is plainly distinguishable from the rest of the column. Usually, in part at all events, the rock is entirely cut away to the sky, so that the block which remains has the appearance of a building constructed in the midst of a vast sunk courtyard, as at Ellora. It is difficult to form any sort of classification, either architectural or chronological, of these excavated temples; but there is one obvious distinction, that in some of them the ceiling is quite flat, as at Elephanta; in others hollowed out, so as to resemble more or less a regular vaulting, as in the temple-cave of Kennery, in Salsette, and that at Carlee.

These rock-cut structures were either *chaityas* (temples) or *viharas* (monasteries); and while the more ancient of them evidently imitate the forms of wooden buildings in stone, the more modern ones bear in general plan and arrangement a striking resemblance to a Christian basilica, with their fore court, and their great hall divided into nave and aisles by columns and terminated by a semicircular apse, in which is the great statue of the temple, under its *dagoba.*

The entrance to the famous Indur Subba at Ellora is shown in the Plate CHINESE AND INDIAN ARCHITECTURE, vol. iv. Many of these rock-cut architectural works, and especially the monasteries, which of course require many small rooms or cells, have built-up constructions without. Others, while excavated, are roofed by vaulting. Indian vaulting is quite distinct from the vaulting so successfully attained by the Romans. It resembles the few vaulted structures of the Greeks which

yet remain. The temple of Mahadeva at Nadone is its most perfect representative, long anterior of course to anything of Roman construction. The layers of stones forming the roof are placed horizontally, but each layer is allowed to project beyond its predecessor, the apex being closed by a circular key-stone. The principle, therefore, is that of a horizontal instead of a radiating pressure, and the edges of all these pressures being rounded off, the spectator sees, on looking up, a vault composed of gradually diminishing circles or annular courses of masonry. In this respect, then, even the earlier Hindu style presents a marked difference from that of the Egyptians, whose edifices are all covered with flat horizontal ceilings. On the other hand, the affinity between the architectural taste of the two peoples is strongly marked by the prevalent use of colossal statues placed against piers or walls; by the use of caryatid figures, or such as serve as columns; by the general disposition of the sacred buildings; and by the profusion of inscriptions and symbolic sculptures on the walls.

Turning to the constructed works, or works wholly above ground, decidedly the most ancient are the *topes*,



Pagoda at Tanjore.

composed as to their outer form of a hemisphere rising from a circular drum, but not domed interiorly, or not markedly so. Most commonly they are nearly solid. These are of two kinds—the topes proper, in which a short spire or pinnacle usually surmounts the sphere, marking a sacred spot or a great event; and the *dagobas*, shrines covering a relic of Buddha or of some Buddhist saint. This peculiar form of the dagoba is typical in Hindu eyes of a bubble of water, to which the Buddhist teaching likens the human frame; it portrays the transitoriness of the things of the earth. The tope built by King Asoka near Sanchi is 121 feet in diameter, and 55 feet high. Among the most markedly characteristic features of early Buddhist Hindu architecture are the beautiful stone inclosures, sometimes called rails, which surround the topes, sacred trees, &c. They are carved so as to exhibit vertical and horizontal bands inclosing beautifully pierced panels worked with forms of natural objects and fine ornamentation. The structure of this kind at Bharhut is 22½ feet high, and measures 275 feet in circumference.

On examining the other Hindu works of construction, or edifices erected above ground, we can hardly avoid being struck by the prevalence of pyramidal masses and forms, as exhibited in pagodas or towers. The Egyptian structures of this kind bear a much closer resemblance to natural or rudely constructed prototypes than do those of the Hindus. The *gopuras*, or pagoda towers erected over the gateways leading to temples, are indeed pyramidal in their general form, but infinitely more complex than, not the pyramid alone, but anything else we meet with in Egyptian architecture. Neither do they terminate in a point or mere platform, but have generally a great deal of ornament bestowed on their summit, which sometimes assumes, not inelegantly, the form of a crown. Besides this they differ from the pyramid in being of far loftier proportions. Of a domical termination, if not exactly a dome, we have an example in the great pagoda at Tanjore, which is considered one of the finest specimens of the kind in India. It has fourteen storeys, and is 82 feet square at the base, rising to over 200 feet in height. Another superb specimen, the pagoda at Chillambaram, is shown in the Plate CHINESE AND INDIAN ARCHITECTURE, before referred to. Other forms of gateways—structures of pillars and cross beams only—remind one somewhat of Chinese works of the kind. The same Plate gives an instance of one of the central pillars of the great gate of this character at the Nerta Chabei Temple, also at Chillambaram. Fergusson's "Indian Architecture" (vol. iii. of his "History of Architecture," London, 1873) is the best compendium of this large subject.

INDIAN INK, a very fine transparent brown black pigment used after the methods of water-colour painting. It is in fact a very pure lampblack, and its preparation is not accurately known. All the best specimens come from China. The black is said to be the soot produced by burning oil of sesamê, and is thickened with some vegetable gum until it becomes solid. A little perfume, usually musk or camphor, is added. For drawing architectural designs, for writing with a brush, for works in black and white, &c., Indian ink still remains by far the most perfect and durable pigment. It is frequently imitated, but with only partial success.

INDIAN OCEAN is the name given to the vast oceanic basin separated from the Pacific on the east by the Asiatic Archipelago and Australia, bounded on the south by a line drawn from the Cape of Good Hope to Bass' Strait, divided from the Atlantic by Africa on the west, and inclosed by the countries of Asia on the north. The principal inlets are the Bay of Bengal, the Arabian Sea and Gulf of Oman, the Persian Gulf, and the Red Sea. Steam packets are established between the principal ports, which are Calcutta, Bombay, Malacca, Aden, Muscat, Zanzibar, &c. The most important islands are Madagascar, Mauritius, Bourbon, &c. The monsoons or periodical winds prevail in the northern part of the ocean.

INDIAN RED, the well-known opaque deep red so useful to artists, both in oil and water colour, is the peroxide of iron. Mixed with white it forms valuable flesh tints.

INDIAN YELLOW is a clear, transparent, golden yellow pigment, of a slightly greenish tinge, prepared usually from camel's dung. It is a favourite colour in water-colour painting, but is sometimes said not to be permanent. The best form of it is the Hindu *purree*.

INDIAN TERRITORY, a large tract of land set apart by the Federal government of the United States for the permanent residence of the various tribes of native Indians removed from the settled states and territories of the Union. It lies between 33° 30′ and 37° N. lat. and 94° and 100° W. lon., bounded south by Texas, east by Arkansas and Missouri, and north by the new state of Kansas; the area is about 71,000 square miles; the Indian inhabitants are estimated at about 70,000. The principal Indian tribes settled in the eastern portion of the territory

are the Choctaws, Chickasaws, Creeks, Cherokees, Senecas, Shawnees, and Seminoles. The central and western portions are roamed over by the Osages, Camanches, Kioways, Pawnees, Arrapahoes, and some other nomad tribes. Some of the removed tribes have made considerable advances in agriculture and the industrial arts, and have established schools and churches.

INDIA'NA, one of the United States of North America, is bounded S.E. by the river Ohio, which divides it from Kentucky, E. by the state of Ohio, N. by Michigan, and W. by the state of Illinois. Its length is 276 miles, and breadth 140 miles—the entire area being 33,809 square miles, or 21,637,760 acres.

The population in 1800 was 4875; 25,520 in 1810; 147,178 in 1820; 685,866 in 1840; and 1,978,358 in 1880. A large number of the inhabitants are Germans.

The Ohio and the Wabash are the most important rivers. The Wabash rises in Ohio and flows thence into this state. Its whole course through Indiana and along its western boundary is between 500 and 600 miles, all navigable except at its falls or rapids. All the other principal rivers of the state are tributaries of the Wabash. The White River is formed of two main branches, of which the northern has a S.W. course of about 300 miles, and the East Fork has also a general S.W. course of 200 miles. The Wabash also receives the Tippecanoe and the Eel River from the N.E., then the Mississinewa from the S.E., and Little River from the N.E. Many streams fall into the Ohio, but none of much magnitude. The same remark applies to those which flow into Lake Michigan.

This state, like Illinois, slopes to the S.W. Like that state also it is, with few exceptions, one great plain. There is indeed a tract of hilly country north of the great bend of the Wabash, and the state is skirted on the south by those eminences called the Ohio Hills, which sometimes touch the Ohio and sometimes retire from it for 2 or 3 miles; they occasionally rise 300 feet above the river. The timbered and prairie lands are more intermixed in this state than is usual; and the alluvial river-bottoms are all wide. The soil is admirably suited for grass and grain. The climate is somewhat more equable than that of Illinois, and milder than that of western Pennsylvania. It is everywhere healthy except in the neighbourhood of the wet prairies and swamps. Iron, copper, coal, marble, lime, freestone, and gypsum are found.

Indiana produces an abundance of wheat, oats, potatoes, butter, cheese, wool, maize, tobacco, and a little cotton; swine and cattle are also reared. The most successful vineyards in the United States are at Vevay on the Ohio. They are managed by the Swiss settlers at that place, and consist of native species of the vine.

There are over 2500 miles of railway in the state, and a canal 467 miles in length, uniting the Ohio River with Lake Erie, passes through it.

The legislative body consists of fifty senators and 100 representatives. The state sends thirteen representatives to Congress. Indiana was included in the cession of Virginia to the United States in 1787. It was placed under a territorial government with Illinois in 1800, and under a separate government in 1809. In 1816 it became a state, and formed its present constitution.

INDIANAP'OLIS, the chief town of the state of Indiana, is situated near the centre of the state, 824 miles W. of New York by rail, on the east bank of White River which is navigable thus far at high water. The population in 1880 was 75,121. It is a regularly built and beautiful city, with a handsome state-house, court-house, and asylums for the blind, deaf and dumb, and insane. A new court-house is in course of erection. It also has a university, two female colleges, nearly seventy churches, and extensive woollen factories, iron-foundries, planing-mills, and flour-mills. Pork-packing is one of the chief industries of the city.

IN'DIANITE is a lime felspar, being a silicate of lime and alumina ($Al_2O_3SiO_2 + CaO\ SiO_2$). It has a hardness of 6 or 7, a specific gravity of 2·6, and is not so easily fusible as labradorite, but is more easily acted upon by acids. It belongs to the triclinic or plagioclastic division of the FELSPARS, and is considered to be characteristic of basic rocks; it is an essential constituent of the rock CORSITE (orbicular diorite). This mineral is often known as anorthite.

INDIANS. This term, once also applied to Hindus, &c., is now usually limited to the natives of North and South America. The misnomer whereby Americans are set down for natives of India is due to the initial mistake of Columbus, who, when he discovered the great American islands, considered he had reached outlying portions of India, to accomplish which was the end of his voyage. Hence we still call these islands the West Indies, while Hindustan used to be called the East Indies. The natives of NORTH AMERICA and of SOUTH AMERICA are treated of in the articles upon those continents.

IN'DICAN is, when pure, a colourless substance which forms the ancient blue dye obtained from dyers' woad, *Isatis tinctoria*, natural order Cruciferæ. *Genista tinctoria*, natural order Leguminosæ, is another woad-plant which also contains this colouring matter. It is also found in human urine and blood. It is obtained as a yellow viscid bitter liquid, soluble in water, alcohol, and ether. It gives a green precipitate with acetate of lead and ammonia. The formula is $C_{26}H_{31}NO_{27}$. When mixed with dilute sulphuric acid, and allowed to stand, it absorbs the elements of water, and a blue compound, indirubin, is deposited. This body is isomeric with indigo blue (C_8H_5NO). Indiglucin ($C_6H_{10}O_6$) and several other products are also formed. With alkalies indican forms indicanin ($C_{20}H_{23}NO_{12}$). Indifulvin ($C_{22}H_{20}N_2O_3$) and indifuscin ($C_{24}H_{20}N_2O_9$) are also products of decomposition.

INDICATOR. See HONEY-GUIDE.

IN'DICES, THEORY OF. In the article INDEX the algebraical use of the term is explained; and it is shown that $a \times a \times a \times a$, or $aaaa$, is expressed as a^4. Similarly $aaaa$ repeated n times would mean a multiplied by itself $n-1$ times, and would be the n^{th} power of a, and consequently would be represented by a^n, where n is any positive integer. But is there any meaning to be attached to such expressions as a^{-n}, or $a^{\frac{1}{n}}$, or $a^{\frac{m}{n}}$, or if we are using arithmetical indices, to such as a^{-4} or $a^{\frac{3}{1}}$ or $a^{\frac{1}{4}}$? That is, can we deal with indices by adding and subtracting them, and if so, what will the results mean?

Fractional Indices.—First, what would $a^{\frac{1}{2}}$ mean? Now since $a^2 \times a^2$ (or aa multiplied by aa) gives a^4 (or $aaaa$), so that we add the indices to arrive at the new power, by the same reasoning $a^{\frac{1}{2}} \times a^{\frac{1}{2}}$ should give a or a^1. But the quantity which, when multiplied by itself, gives a, is the square root of a; $a^{\frac{1}{2}}$ therefore means $\sqrt[2]{a}$ or $\sqrt{a}$, as it is usually written. So also $a^{\frac{1}{4}}$ means $\sqrt[4]{a}$, the fourth root of a. In a similar way we can see that $a^{\frac{3}{4}}$ means $\sqrt[4]{a^3}$ the fourth root of a^3; and in general $a^{\frac{m}{n}}$ means $\sqrt[m]{a^n}$, the m^{th} root of the n^{th} power of a.

Negative Indices.—Next it is required to define the expression a^{-4} (or a^{-n}). Now since $a^2 \times a^2 = a^4$, and $a^2 \times a^3 = a^5$, &c., it follows that we might express $a^3 \div a^2$ (a^3 divided by a^2) by a^{3-2}, with result a^1 or a. So in general we might write a^{m-n}, meaning a^m divided by a^n (a to the m^{th} divided by a to the n^{th}). But since a^{m-n} multiplied by a would of course give a^m, it is evident that since the expression a^{m-n} is converted to a^m by being multiplied by a^n, therefore a^{m-n} may be written fractionally,

taking the form $a^{\bar{n}}$. Hence it follows that the exponent a^{-n} means $\frac{1}{a^n}$, that is to say, a^{-n} is the reciprocal of a^n, or unity divided by a^{-n}.

It comes about, as might be expected, that sometimes indices are quite irrational; thus $a^{\frac{2}{3}}$ (or $\sqrt[3]{a^2}$) manifestly cannot be reduced; such expressions are called irrational quantities or SURDS.

INDIC'TION, ROMAN, or **PAPAL INDICTION,** an arbitrary method of reckoning time still used by the popes in dating their state documents, consisting of cycles of fifteen years, beginning the 1st of January, 313. The origin of the Roman indiction is not known; certainly it was not papal. It originally began from 15th September, 312, but the date was altered to the more convenient one above-named by the popes. As our era began with what would be the fourth year of an indiction, it is necessary to add three to the year of the Christian era before dividing by fifteen to ascertain the position of that year in an indiction. Taking 1890 as a specimen, one-fifteenth (1893) gives us 126 and remainder 3. This then is the third year of the one hundred and twenty-seventh indiction after Christ. The word indiction meant ordinarily *taxation*, but the connection with its chronological sense is obscure. The student of archæology will frequently find muniments of all sorts in the dark ages dated by the papal indiction.

INDICT'MENT (pronounced *indite-ment*) is a written accusation against one or more persons of a crime or misdemeanour referred to and presented by a grand jury. The decision of the grand jury is not a verdict, but merely the expression of their opinion that the matter is fit to be submitted to the common jury; and in conducting the inquiry the evidence in support of the accusation only is heard. If the grand jury think the accusation groundless, they indorse upon the bill "not a true bill," or "not found;" if the contrary, "a true bill;" and in finding a true bill twelve at least of the grand jury must concur. When a bill is found to be a true bill, the trial of the accused takes place in the usual form; and when the bill is found not to be true, or, as it is frequently called, "ignored," the accused is discharged, but a new bill may be preferred against him before the same or another grand jury.

In Scotland, where the grand jury is never summoned unless in cases of treason, an indictment means the form of process by which an accused person is brought to trial at the instance of the lord advocate. It runs in the name of that official and is addressed to the accused, and specifies the crime charged, the names and addresses of the witnesses, and all documents or other articles to be used in evidence, the time, place of trial, and the names and addresses of the jurors from whom what would in England be called the petty jury is to be chosen by ballot. Where a private party joins in the prosecution his name may be added to that of the lord advocate. Where again a private party is the principal prosecutor, he must obtain the concurrence of the lord advocate; but in that case, instead of indictment, the form of "criminal letters" is used. These run in name of the sovereign, and contain the same information as an indictment. They are often employed even when the crown prosecutes directly. When the crime is to be tried before an inferior court the analogous writ is termed a criminal libel, and runs in the name of the sheriff of the county or other presiding official. See CRIMINAL PROCEDURE.

INDIGES'TION or **DYSPEP'SIA.** Indigestion is perhaps the most common malady of civilized life. It affects all classes of society, and it appears at all periods of life, though it is not often experienced during the years of childhood and youth. The process of digestion in a normal or healthy condition of the body has already been explained [see DIGESTION], and it will only be necessary here to note that in ordinary life there are many things which tend to interfere with the regularity of this process. Among these the use of articles of diet upon which the gastric juice of the stomach exercises little or no solvent action, the habit of bolting the food in tough lumps and unchewed masses, prolonged abstinence, or a too rapid succession of meals, the taking of food either solid or fluid in excessive quantity, insufficient exercise, excessive labour, either physical or mental, a disturbed or anxious state of mind, and a condition of general weakness or debility, are only a portion of those which might be enumerated.

The symptoms of indigestion vary very much both in nature and severity, and when given at length, as by some medical writers who have aimed at giving a complete list, they seem to include almost half the aches and pains to which humanity is liable. Perhaps the most prominent symptoms of indigestion are a deranged appetite, which may be either languid or ravenous, pain or a feeling of weight or sinking in the stomach, sickness, flatulence, acidity, heartburn, costiveness or its opposite diarrhœa, a furred tongue, and an offensive state of the breath, headache, giddiness, and a general feeling of languor, and want of strength. Sometimes there is a sensation of shortness of breath, and there may be palpitation of the heart; while there is in almost every confirmed case of dyspepsia a good deal of mental and nervous disturbance, the sufferer being either lethargic, low spirited, or irritable and ill-tempered. Very frequently persons imagine themselves to be the victims of serious organic disease, and undergo much distress on account of it, when the sole cause of the trouble is a disordered state of the digestive powers.

The treatment of indigestion must obviously depend upon the particular symptoms and circumstances of the patient, and a few general observations are all that can be attempted within the limits of this article. In all cases attention to the diet is of the first importance, and in many cases is of itself sufficient to effect a cure. Among animal foods it has been found that beef, mutton, fowls, and game are the most easily digested, and that pork and veal and all hardened or cured meats, such as ham, dried tongue, salted beef or pork, dried or smoked sausages, &c., are the most difficult for the stomach to deal with. Eggs, fish, and oysters are usually digested easily, but there are some to whom they cause disturbance. Raw vegetables, such as salads and cucumbers and pickles, are unsuited to dyspeptics, while shell-fish, nuts, and cheese are articles of diet that have also a bad reputation. Vegetables when taken should always be well and carefully cooked, and when this condition is attended to they are often most useful articles of food. Where they give rise to flatulence, their place may be taken by rice or macaroni, or the use of a little fresh or cooked fruit. Stimulants, as a general rule, are best avoided, but sometimes the use of a moderate amount of alcohol is attended with considerable benefit. Very often there is an individual susceptibility to some particular article of diet, and when this is avoided the digestion quickly recovers its power. Tea taken to excess, for instance, is frequently a cause of dyspepsia, though most people use it with impunity, and the immoderate use of tobacco is often attended with similar results. All food should be well and carefully masticated, and when through defective teeth this is impossible, the food should be cut up small, so that the gastric juice may have the largest possible extent of surface presented to its action. Meals should not be taken too quickly after each other, as the stomach requires rest and should have time to perform one task before another is imposed. Dr. Abernethy was in the habit of advising his patients to allow five or six hours to elapse between each meal, and when meals can be taken with moderate regularity the practice of eating between them should be carefully avoided. Very great benefit is derived from moderate exercise in the open air, though it must not be pressed to the point of undue fatigue, and the

practice of cold or tepid bathing accompanied with friction of the skin is also very beneficial. A change of scene and air, such as may be obtained by a tour among the mountains of Scotland or Switzerland, or a sea voyage will often effect more for the cure of dyspepsia than any medicinal treatment whatever, though often both may be combined with advantage. The hydropathic treatment of indigestion, which is frequently very successful, has already been referred to. See HYDROPATHY.

With regard to the medicines used in the treatment of indigestion, where it is accompanied with pain, bismuth or arsenic may be taken in appropriate doses about half-an-hour before meals. In cases of loss of appetite the different vegetable bitters, such as gentian, calumba, cascarilla, camomile, and hops are frequently employed, either alone or in combination with alkalies or acids. Alkalies have the power of increasing the secretion of the gastric juice, and acids, when taken about half-an-hour after a meal, will often greatly aid digestion. Pepsin taken immediately after a meal is a favourite remedy for many forms of dyspepsia, and it undoubtedly gives valuable assistance in such cases to the digestive process. Flatulence may be relieved by the use of carminatives, and costiveness where it exists must be removed by means of gentle laxatives, the daily use of an enema of cold water, or the use of the wet compress over the abdomen. [See CONSTIPATION.] Persistent diarrhœa may be cured by the use of a very small dose of opium taken in a little water before eating, and belladonna has been used with advantage in a similar way, though of course such powerful drugs can only be used under medical advice. See also DIARRHŒA.

INDI'GETES, among the classical ancients, a name given to the local or inferior divinities, or to demi-gods who had existed on earth, and from their meritorious deeds were entitled to divine honours. Of such were the Latin Hercules, Latinus, Romulus, Æneas, Janus, Picus, Faunus, &c. The Indigetes are classed with the Lares and Penates or household gods.

IN'DIGO BLUE or **INDIGOTIN**. This blue dye has been used from very early times, as we may gather from there being a Sanskrit word for it—*Nili*. The Portuguese in their early commerce with India called it *anil*, and hence we get the word *aniline* for the well-known substance first obtained from indigo in 1840 by Fritsch. The ancient Egyptians were well acquainted with the dye, for cloth coloured with indigo has been found in their tombs. Dioscorides calls it ἰνδικόν, Pliny *indicum*, and these names show that the Greeks and Romans obtained a knowledge of its use from India. The description of the process given by Dioscorides agrees with the crude method still used in Bengal. An identical substance occurs in Woad (*Isatis tinctoria*), with which the ancient Britons, as Julius Cæsar tells us, were wont to paint their bodies.

Woad was cultivated in Europe till after the discovery of the passage to India by the Cape. Since that time the indigo plant has gradually taken its place, though severe laws were passed against its introduction. Henry IV. of France issued an edict condemning to death anyone who used "that false and pernicious drug called inde." The Chinese and Japanese get their supply chiefly from a plant called *Polygonum tinctorium;* and there are other plants from which indigo may be prepared. The most important surce of indigo, however, is *Indigofera tinctoria*, which is extensively cultivated in India and America.

It is sometimes deposited from human urine. It is probable that these plants contain indican ($C_{26}H_{31}NO_{17}$), which, by absorbing the elements of water, is converted into indigo blue, which has the formula C_8H_5NO; indiglucin ($C_6H_{10}O_6$) being formed at the same time. The colouring matter does not exist ready formed in the plant, and it was formerly supposed that it existed as indigo white, a colourless compound having the formula C_8H_6NO, and that the blue colour was formed by oxidation. Schunk has shown, however, that this substance requires free alkali for its solution, and the sap of the plant is acid, and therefore cannot contain it. India is the principal seat of the manufacture. The plants are steeped in water and allowed to ferment at 30° C. (86° Fahr.); the fermentation takes about twelve hours; the liquid is drawn off and kept in agitation for two hours, and then allowed to settle; the indigo which deposits is boiled with water for several hours and filtered off. The plants yield about 0·05 per cent. of indigo. It contains about 50 per cent. of pure indigo blue. It may be purified by subliming it or by reducing it with protosulphate of iron, and dissolving it with carbonate of potash; on exposing the solution to the air pure indigo is deposited, or it may be precipitated by the addition of hydrochloric acid. A similar method is adopted in the dye-bath for fixing it on fabrics.

Indigo sublimes in beautiful rhombic prisms, which present a dark red metallic lustre by reflected light, and a deep blue colour by transmitted light. It is insoluble in water, ether, alcohol, and oils. It is inflammable, burning with a bright smoky flame. Commercial indigo occurs in small pieces which, if good, should float on water, and present a coppery surface when rubbed. It should not contain more than 10 per cent. of ash. It is bleached by chlorine, and the strength of the indigo is usually tested by the amount of chlorinated lime required to decolourize it. There are several other colouring matters in indigo, known as indigo red, purple, brown, and green.

Indigo combines with fuming sulphuric acid, forming a deep blue solution known as Saxony blue or sulphindigotic acid ($C_8H_5NO\ SO_3$). This acid in the pure state presents a blue mass, soluble in water and alcohol; the solution is completely decolourized by wool, which absorbs and removes the blue colour. It forms with bases a large number of salts called sulphindigotates, which are dark blue with a coppery lustre, and uncrystallizable.

In dissolving the indigo in fuming sulphuric acid, a purple powder generally remains as a sediment; this is sulphophœnicic acid ($2C_8H_5NO\ SO_3$) or indigo purple: it is soluble in water, but insoluble in dilute acids. It forms salts, which are blue in solution and red when dry.

Indigo has recently acquired great interest from its artificial production in the laboratory. This important discovery is due to Baeyer. It was first made from ortho-nitro-benzoic acid, then from ortho-nitro-phenyl-acetic acid; these sources were too expensive for manufacture on the large scale, and Baeyer now obtains it from cinnamic acid; the only source of this acid was formerly balsam of Peru, or gum benzoin, both expensive sources. Perkin has, however, shown how this acid can be produced artificially from toluene (C_7H_8) by converting it first into benzylene dichloride ($C_7H_6Cl_2$), and then acting on it with sodium acetate. The manufacturing process devised by Baeyer, which is one of the most recent triumphs of organic chemistry, is as follows:—The cinnamic acid is first converted into ortho-nitro-cinnamic acid by the action of nitric acid. This compound is then converted into the dibromide by bromine; this product is carefully treated with caustic soda, which converts it into ortho-nitro-phenyl-propiolic acid; this solution treated with glucose gives indigo blue, carbonic acid, and water, as shown in the following reaction:—

$$\underbrace{C_6H_4(NO_2)C_2CO\ OH}_{\text{Ortho-nitro-phenyl-propiolic acid.}}+H_2=\underbrace{C_8H_5NO}_{\text{Indigo blue.}}+CO_2+H\ O.$$

This remarkable reaction has already become the starting point of a most important chemical industry, and bids fair ultimately, as in the case of alizarin, to drive the natural product from the market. See INDIGOFERA.

IN'DIGO WHITE or **DEOXIDIZED INDIGO** has the formula $C_{16}H_{12}N_2O_2$, and differs from a double

molecule of indigo by two atoms of hydrogen. It is a white powder with a silky lustre, insoluble in water but soluble in alkalies, alcohol, and ether; the solutions deposit indigo blue on exposure to the air.

INDIGOF'ERA, a genus of plants of the order LEGUMINOSÆ, indigenous in the equatorial parts of Asia, Africa, and America, and celebrated for some of the species yielding indigo. The species are about 220 in number, all herbaceous or shrubby plants. The leaves are pinnate, with five or six pairs of leaflets, sometimes digitate with three leaflets, and sometimes with a single leaflet. The flowers are papilionaceous, rose or purple, occurring in racemes or spikes; one stamen is free; the pod is rounded, four-cornered, or flat. *Indigofera tinctoria* is the species generally cultivated in India, whence it has been introduced into America. It is an erect, branched, and shrubby plant, growing 3 or 4 feet high; the leaves have five or six pairs of obovate leaflets; the pod is somewhat curved, and contains about ten seeds.

The cultivation is also carried on in America. In the spring the seeds are sown at the rate of about a dozen pounds per acre. The plants grow rapidly, beginning to blossom in about three months, when they are cropped and allowed to grow till sufficiently matured to admit of another cutting. Occasionally a third and even a fourth cropping is made, but each of these contains less and less of the colouring matter that yields the colouring principle. When the plant is in full flower it contains most colouring matter. It is then cut, and put into vats and covered with water; fermentation takes place, accompanied with the evolution of carbonic acid and of other gaseous products, and the copper-coloured liquor is covered with a froth, which in a little time becomes of a violet colour. The liquor is then run off into another vat, placed at a lower level than the first. Here it is brought well into contact with the air by being beaten with wooden paddles for about an hour and a half. During the beating the liquor darkens in colour, and the indigo separates into flocks. These are allowed to subside, heated to boiling in order to remove certain impurities, then collected on wooden strainers, and finally pressed, dried, and the mass cut up into blocks for sale. The usual appearance of indigo as it occurs in commerce is that of nearly cubical cakes of an intense blue colour and earthy fracture. Indigo seldom contains more than about half its weight of pure colouring matter, and frequently much less.

Indigofera cærulea is an Indian species described by Dr. Roxburgh, who states that from the leaves he had often extracted a most beautiful light indigo, more so than he ever could from the common indigo plant. It flowers during the wet and cold seasons. A. de Candolle is inclined to consider it a variety of the following species. *Indigofera argentea* is the species cultivated in Egypt and Barbary for the sake of its indigo. It is indigenous in Abyssinia, Nubia, Kordofan, and Sennar.

IN'DIUM, a metal discovered by spectrum analysis by Richter in zincblende. Its compounds give a violet tint to flame, and the spectrum gives two bright blue lines, which led to its discovery. It has only been isolated in small quantity. The metal is silver white; it is soft, malleable, and ductile. The atomic weight is 75·63, and the symbol In. Freiburg zinc contains 0·04487 per cent. of indium. The specific gravity is 7·421. It melts at 176° C. (349° Fahr.), and is permanent in the air, but at a red heat it burns with a violet flame, and forms the yellow oxide (InO). It is obtained in the metallic state by reducing this oxide with hydrogen, or by fusing it with sodium. It is soluble in dilute hydrochloric and sulphuric acids, with evolution of hydrogen. It is precipitated from solution by metallic zinc, also by sulphuretted hydrogen in neutral and slightly acid solutions, as sulphide; caustic potash and soda precipitate the oxide, which is soluble in excess of the alkali. The chloride ($InCl_2$), bromide ($InBr_2$), and iodide (InI_2) are prepared by combining the elements, and present yellow crystalline masses. There are two oxides; the monoxide (InO), a pale yellow powder, and the dioxide (In_2O), a black powder. These oxides form crystallizable salts with all the ordinary acids.

INDO-EUROPEAN FAMILY OF LANGUAGES. This great family of tongues some prefer to call Aryan, and others, with far less reason, Indo-Germanic; but the term Indo-European seems on the whole preferable, as at once giving an indication of the primal cradle of the ancestral Aryan race in the plateau of Central Asia, and of the present homes of the two great divisions of its numerous descendants. These languages naturally divide into those sprung from the ancient Sanskrit of India and the European tongues independently originating from the Aryan. As regards the Aryan origin and the conjectural development of the principal Indian nations (including the Afghans, the Persians, and the Armenians) and of almost the whole of the European stocks, the article ARYAN gives as complete an account as the limits of this work allow. It remains here to set forth in a complete table the families of speech, sometimes, as has just been said, included under that same title, but more commonly under the heading of this article. The great Indo-European family of languages has, then, two main divisions, the Asiatic and the European.

A. *Asiatic Division.*—This comprises two great groups, the Indian languages and the Persian, with some isolated tongues.

The Indian group of the Asiatic division includes, (1) the very ancient and long since "dead" Sanskrit, one of the most ancient tongues of the world, preserved to us in the Vedas and other Brahmanic scriptures—not, however, to be by any means regarded as the original Aryan language, but rather as one of its earliest offshoots; (2) the scarcely less ancient Prakrit, local dialects preserved in Sanskrit dramas; (3) Pali, the sacred language of the Buddhists, and the kindred Cingalese of Ceylon; (4) modern Hindi, modern Hindustani, modern Bengali, modern Marhatti; and (5) the Romany or Gypsy tongue, these wandering people being shown by their language to be of Indian origin.

The Persian group of the Asiatic division includes, (1) Zend or ancient Iranian, preserved in the ancient Zend-Avesta, the sacred books of the Persian religion of Zoroaster; (2) the ancient Persian, preserved in the cuneiform inscriptions of Darius and Xerxes from about 500 B.C. onwards; (3) Pehlevi, the language used under the Sassanian dynasty of the first centuries of our era (rising from about 200 A.D. to 650); (4) Parsee; and (5) the modern Persian, differing little from Parsee, and dating from about 1000 A.D., shortly after which the great "Shah Nameh" (epic of kings) of Firdusi was written.

The isolated tongues of the Asiatic division are the Armenian, the Afghan, the Ossetic of the Caucasus, and the Kurdish of the districts round Mount Ararat.

B. *European Division.*—This comprises six great groups—the Keltic (or Celtic), the Hellenic, the Italic or Romanic, the Teutonic, the Slavonic, and the Lettic or Lithuanian. (The only other languages of Europe which do not belong to the Indo-European family are the Turkish, the kindred Magyar, the Basque, the Lapp, and the Finnish and Esthonian tongues.)

The Keltic group of the European division includes, (1) the Cymric tongues—Welsh, Cornish (extinct), and Breton; (2) the Gaelic tongues — Erse (ancient Irish), Gaelic (ancient Scotch), and Manx, spoken in the Isle of Man.

The Hellenic group of the European division includes, (1) the ancient Greek, in the four great classical varieties of Attic, Ionic, Doric, and Æolic dialects; and (2) modern Greek, its direct and lineal descendant. The Albanian, a kindred speech, has peculiarities which point to its being

possibly the tongue of Aryan settlers of very early times before the great Hellenic wave occupied the peninsula of Greece.

The Italic group of the European division includes, (1) Italic languages before the Latin, as the Oscan of South Italy, still traceable at Naples, &c., the Umbrian of North-east Italy, and the Sabine; (2) Latin; (3) the descendants of the Latin, commonly called the Romance languages, the result of the vast imperial dominion of Rome, which imposed its tongue and its laws upon the many nations whom it gathered under its rule. These are modern Italian, French, Provençal, Spanish, Portuguese, the Romansch of the Southern Swiss, and the Wallachian or Roumanian.

The great Teutonic group of the European division (of which English is a member) is subdivided into three parts, respectively called the Low German, the Scandinavian, and the High German groups. The Low German group includes, (1) Gothic or Mœso-Gothic, the language of the ancient Ostrogoths and Visigoths, preserved to us in some fragments of the Gothic translation of the Scriptures of the early part of the fourth century by Bishop Ulfilas; (2) Frisian, the old Frisian and its modern descendant, spoken by the coast peoples of the North Sea, and the nearest approach to English of all this group; (3) Dutch, both old and modern; (4) Flemish, both old and modern; (5) Saxon, the ancient dialect of the Rhine and Elbe districts, the language of the HELIAND, and remarkable for the number of ancient Teutonic inflexions that it has preserved; and (6) English, both Old English, sometimes even yet called Anglo-Saxon, a misleading term that is happily fast becoming obsolete, and Middle and Modern English. The Scandinavian subdivision of the Teutonic group includes, (1) Icelandic, a very pure and old dialect, sometimes called Norse, dating from before the year 1000; (2) Norwegian; (3) Swedish; (4) Danish. The High German subdivision of the Teutonic group is the language of inland Germany, which has become the literary German of the present day, and is divided, like English, into Old, Middle, and Modern High German.

The Slavonic group of the European division includes first an eastern branch of three varieties—(1) Bulgarian, or Old Slavic, dating from the eleventh century; (2) Russian, (3) Illyrian, comprising Servian, Croatian, and Styrian; and secondly, a western branch of five varieties—(1) Polish; (2) Bohemian or Czech; (3) Slovak; (4) Lusatian or Sorbian; (5) Polabian or Elbe tongues.

Finally, the Lettic group of the European division includes, (1) Old Prussian, the ancient speech of East Prussia, the extreme south-easterly corner of the Baltic shores; (2) Lettish or Livonian, the speech of Courland and Livonia; and (3) Lithuanian, the present speech of East Prussia. All these peoples, now so numerous and diverse as to make the mere catalogue of them given above quite a long list, have descended, without doubt, from one common stock having an archaic language and customs, and, as we roughly compute, first sending out feelers to the westward about 3000 years ago. All these tongues have grammatical peculiarities and actual words, or the roots of words, in common, and by the latter we can guess at a large part of this primeval civilization. The results of these guesses are told in the article ARYAN.

IN'DOL is a weak base, and is regarded as the nucleus of the indigo group. It is a crystalline substance, having the formula C_8H_7N, and is obtained from nitrocinnamic acid, $C_9H_7(NO_2)O_2$, by the abstraction of CO_2 and O_2, by fusing it with caustic potash and iron filings. It melts at 52° C. (149° Fahr.) It is soluble in alcohol and ether, but insoluble in water. The alcoholic solution with hydrochloric acid colours firwood red; it forms also a number of other red compounds which are characteristic. There is a large series of oxygen and other derivatives.

INDORE. One of the principal native states in Malwa or Central India, being coextensive with the territories of the Holkar dynasty. The area is 8000 square miles, and the population 640,000. The state consists of many isolated tracts, but since 1861 arrangements have been made to concentrate the territory as much as possible.

The northern parts of the state are watered by the Chambal and its tributaries, and the tracts to the south by the Nerbudda. This southern division is traversed by the Vindhya range, running across it from east to west. It forms a section of the Nerbudda valley, and is bounded on the south by the Satpura Mountains. The Nerbudda flows in a deep channel between precipitous banks of basaltic rock, and during the rains rushes down with great rapidity and in a large volume of water. The valley of Mandlesar, in the centre of the state, has an elevation of between 600 and 700 feet above sea-level. The general appearance of the country is that of an undulating valley, intersected by low rocky ranges, in some parts thickly clothed with stunted jungle, consisting of *dhak*, *babul*, and other scrub-wood, which also covers considerable tracts in the plains. Like the rest of Malwa, the soil of Indore is fertile, consisting largely of the rich black loam known as "cotton-soil." The principal crops are wheat, rice, millets, pulses, oil-seeds, sugar-cane, and cotton. The soil is peculiarly suited to the growth of the poppy plant, the cultivation of which is very general. Tobacco of excellent quality is also grown to a considerable extent. The forests of the state may be said to form two belts, one in the south bordering on the Satpura range, which is considered to be malarious, and another and healthier in the Vindhyan Hills. Teak is being cultivated, and encouragement is given to the production of lac. Wild animals include the tiger, leopard, hunting leopard (*cheetah*), lynx, hyæna, jackal, and fox, *nilgai* (*Portax pictus*), and two species of wild cattle, the bison (*Gavæus gaurus*), found in the Katkut and other jungles, and the wild buffalo (*Bubalus arni*) of the Satpuras. Crocodiles and several varieties of venomous snakes are found.

The ruling class in Indore are Marhattas; and there are the usual other subdivisions of Hindus, a few Mohammedans, with a considerable number of the aboriginal tribes of Gonds and Bhils. The Vindhya and Satpura ranges are the especial home of the Bhils, where they have been settled from time immemorial. This race is one of the wildest in India, living for the most part on jungle products and game, or on the plunder of their more civilized neighbours. They have, however, of late years been brought into more peaceable habits of life; and many of them are now employed as soldiers and police, in which capacity they have proved themselves useful and trustworthy.

The principal public work undertaken of late years in Indore has been the introduction of the general railway system of India. A branch from the Great Indian Peninsula Railway, under the imperial department of public works, now runs from Khandwa junction (353 miles from Bombay) through Mhow to Indore city, a distance of 86 miles. The maharajah ceded the land required for the railway free of charge, and the British government has full jurisdiction, short of absolute sovereignty, over it. There are several cotton mills in the state, and opium manufacture is another important industry.

The revenue of the state amounts to about £500,000 per annum. Within the last few years there have been instituted civil and criminal courts of justice, public works, and postal departments, together with improvements in the system of jail management. One of the principal institutions in the state is the Residency (Rajkumar) College at Indore, for the education of the sons of the chiefs and gentry of Central India, affiliated to the Calcutta University. The college has upwards of 200 boys on the

roll, and the principal, by desire of the chiefs, exercises a general supervision over the state schools throughout Malwa. The climate is sultry, the temperature ranging from 60° to 90° Fahr. within doors. The annual rainfall at Indore averages 35 inches. Cholera frequently prevails in the state.

INDORE, the chief town of the above state, and capital of Holkar's territories, is situated on the left bank of the Katki or Kan River. It is the residence of the maharajah, and of the resident or assistant to the governor-general for Central India. As a city it is small and of modern date, built by Ahalya Bai about 1770, after the death of Malhar Rao, the founder of the state. The court of Holkar was transferred to Indore in 1818; and it is now a prosperous city, with an estimated population of 15,000, and connected by rail with the railway systems of Bombay and Northern and Eastern India. The city stands on an elevated and healthy site, nearly 2000 feet above sea-level. The spacious palace, with its lofty, many-storeyed gateway, is conspicuous from every point. The other chief objects of interest are the Lal Bagh or garden, with its pleasant summer palace and interesting collection of animals, the mint, high school, market-place, reading-room, dispensary, large cotton mill, &c. To the west of the city is an antelope preserve, where sport with the hunting-leopards takes place. The residency is a handsome and substantial stone house, situated in a beautiful park, through which the river flows.

IN'DRA, the son and practically the supplanter of Dyaus (Zeus) in the ancient Hindu mythology of the Vedas, is as supreme in the Sanskrit Olympus as Zeus in the Hellenic. In fact, though Dyaus is undoubtedly the same word as Zeus and as *Ju* in Ju-piter, it is to Indra and not to Dyaus that we must look for the attributes of the king of heaven. It is manifest that while Dyaus, the king of the archæan gods of the Aryans, retained his supremacy among the European branches of the great Indo-European family, he had been supplanted by Indra for practical worship, much as in classical mythology we are told Kronos was supplanted by Zeus or Ouranos by Kronos.

Dyaus is the god of the rain-giving sky, etymologically: Indra is the god of rain, *indu* being drop-sap. In the Vedas he is the cloud-compeller, the thunderer, the rain-bringer; he shatters the clouds with his bolt and frees the imprisoned waters. Thus he gives fertility to the land. It is in his perpetual fight with the cloud-god Vritra for the benefit of mankind, from whom Vritra would willingly withhold the precious rain, that Indra thus displays his sovereign power. But in the later Puranic times the supremacy of Indra waned. He had come to be regarded as a sort of heavenly warrior, and a loftier conception of the godhead had sprung up. He is represented in the Puranas as inferior to Vishnu, and as even worsted in conflict with him under the incarnation Krishna. He is still recognized, however, as one of the eight guardians of the world, his quarter being the east; and his functions as the rain-giver and the thunderer still continue to be attributed to him. In the ancient Indian sculptures Indra is represented as riding upon his elephant, with a tree growing out of his head.

INDRE, a department in France formed out of the western portion of the old province of Berri, is bounded N. by the department of Loir-et-Cher, E. by that of Cher, S. by those of Creuse and Haute Vienne, and W. by those of Vienne and Indre-et-Loire. It measures 64 miles in its greatest length, with a mean breadth of 54 miles. The area is 2624 miles, and the population in 1882 was 287,205.

The department is generally very flat; the only hills of any considerable size are the granitic swells on the southern border, and the gentle slopes that diversify the valleys of the Creuse and the Indre. The surface presents three marked and distinct divisions. The first, called *Bois-Chaud*, comprises seven-tenths of the whole department, including the arrondissement of La Châtre, a great portion of those of Châteauroux and Le Blanc, and a third of that of Issoudun; it is divided, where arable, into a great number of small farms, and presents a very varied appearance, from the number of its hedges, ditches, and woods. The second division, distinguished by the name of *Champagne*, is a flat treeless country, without hedge or inclosure of any kind, divided into large farms, and comprising two-thirds of the arrondissement of Issoudun and a part of that of Châteauroux. The third division, called *La Brenne*, comprises parts of the arrondissements of Châteauroux and Le Blanc, and presents a flat surface, without inclination, and covered with shallow ponds, which rest on a bottom of compact clay, and which, by their pestilential exhalations, are very injurious to health. The land varies greatly in quality, from light moss or barren sand to stiff clay, and from the vegetable mould, half covered with flints, to the rich homogeneous soil called *terre de Beauce*, which is considered the most productive, and covers 194,790 acres. The flinty soils, amounting to 111,626 acres, are best adapted for vine culture. All the land capable of cultivation is tilled, but agriculture is in a backward state.

The department takes its name from the Indre, which rises just within the department of Creuse, and entering that of Indre, flows N.W. past St. Sévère, La Châtre, Châteauroux, and Châtillon, below which it enters the department of Indre-et-Loire; here passing Loches, where it becomes navigable, it continues in the same direction as far as Montbazon, and then turning W. passes Azay-le-Rideau, below which it enters the Loire between the embouchures of the Creuse and the Vienne. Its whole length is 124 miles, of which 44 are navigable; its mean width 98 feet, and its ordinary depth from 5 to 6 feet. It is subject to floods, which rise from 10 to 11 feet at their highest, and spreading beyond the banks sometimes do great damage, but add largely to the fertility of the soil. The number of mills along the banks of this river is considerable. The south and south-west of the department is drained by the Creuse and its feeder the Anglin, which is itself increased by the Abloux. See CREUSE.

The west of the department is drained by the Claise, a feeder of the Creuse, which flows through the marshy district of Brenne; and the east and north are drained by feeders of the Cher, namely, the Aron, which receives the Théols, and the Fouzon, fed by the Nahon.

The department is crossed by a railway, which branches off from the Orléans-Bourges line at Vierzon, and runs through Issoudun to Châteauroux.

Wine and corn are produced in quantity more than enough for the consumption; buckwheat, hemp, flax, chestnuts, and fruits are also grown. The annual produce of wine is 6,600,000 gallons, about one-half of which is exported. Although the pasture land is of no great extent, yet considerable numbers of horned cattle are kept; hay is saved for their winter food, and in summer the scantiness of the pasture is eked out with the leaves of trees, especially with those of the elm. Sheep are a source of great profit to the farmer on account of the fineness of their wool; the quality of the wool of the Champagne district especially is very superior. The sheep are very carefully tended; ewes, lamb-hogs, and wethers are kept in separate flocks, each under its own shepherd; they are never folded. When the winter is severe they get a mixture of hay and straw three times a day. Great numbers of geese and turkeys are reared, and also mules, pigs, and horses. The climate is mild and healthy, except in the Brenne district, where the atmosphere is almost always charged with pestilential fogs. Several iron mines are worked; marble, millstone, limestone, mica, flint, lithographic stones (the best in France), granite, quartz, spar, marl, potter's clay, &c., are found.

The cloth manufactures of CHÂTEAUROUX, the capital, and some other places are important; linen, hosiery, scythes, paper, porcelain, and earthenware are made. There are also numerous establishments for the manufacture of woollen yarn, leather, parchment, beer, &c. The commerce of the department is composed of the various agricultural and industrial products named.

The department is divided into the arrondissements of Châteauroux, Le Blanc, Issoudun, and La Châtre.

IN'DRE-ET-LOIRE, a department in France, formed out of the old province of Touraine, is bounded N. and N.E. by the departments of Sarthe and Loir-et-Cher, E. and S.E. by those of Loir-et-Cher and Indre, S. by those of Indre and Vienne, and W. by those of Vienne and Maine-et-Loire. Its greatest length from N. to S. is 70 miles, from E. to W. 59 miles. The area is 2360 square miles, and the population in 1882 was 329,160.

The department takes its name from the Indre, noticed in the preceding article, and the LOIRE, which crosses it from east to west. The other rivers which ultimately or directly enter the Loire on the left bank are the CHER, which throws off several arms to the Loire, forming islands, before its main stream enters that river; the Claise, which crosses the southern angle of the department; the Creuse, which forms part of the south-western boundary; and the Vienne, which enters this department at the point where it is joined by the Creuse, and, flowing in a north-western course past Chinon, enters the Loire on the extreme western boundary of the department. On the right bank the feeders of the Loire in this department are the Brenne and the Doit. The Doit rises in a pond west of Savigné; flowing south past Bourgueil, it turns west, and under the name of Authion runs for the distance of 40 miles parallel to the Loire, which it enters in the centre of the department of Maine-et-Loire at St. Aubin-des-Ponts-de-Cé, south of Angers. Except the Brenne, the Doit, and the Claise, all the rivers mentioned are navigable. The department is traversed by the railways from Paris to Bordeaux, Paris to St. Nazaire, and Tours to Le Mans.

The Loire and its principal feeders are subject to great inundations, which frequently do incalculable damage to property on their banks. One of the most disastrous overflows of this kind on record occurred in October, 1846, when in one night the Loire rose 20 feet, and continued to rise for two days, sweeping away bridges and viaducts, and destroying many lives, and property to the amount of about £2,000,000 sterling. On ordinary occasions such disasters are prevented by the enormous dykes that line both banks of this great river from the neighbourhood of Blois to the mouth of the Authion before mentioned, a distance of 93 miles. The dykes are 22 feet wide on the top, and so high as to intercept the view of the low grounds from passengers by the steamers that ply on the river; the parts most exposed to the flood are faced with uncemented masonry. The high road runs along the summit of the dyke on the right bank, and presents one of the finest drives in the world, curtained with poplars and diversified by the views of villas, towns, populous villages, and those curious dwellings hollowed out in the sides of the rocky hills that now and then approach the right shore.

To the north of the Loire the surface of the department is hilly, and presents three extensive forests and several vast and barren wastes. The cultivation here is still rude, and the population scanty. Along the banks of the Loire, however, a very different landscape is presented; well-cultivated fields, luxuriant pastures and meadows, vineyards and orchards, attesting equally the fertility of the deep alluvial soil and the industry of the inhabitants. Between the Indre and the Vienne occurs a remarkable table-land, containing an immense deposit of fossil shells, which are used as manure. The great forests south of the Loire are those of Amboise, Loches, and Chinon. On the slopes surrounding the forest of Amboise grow the vineyards that yield the rich Cher wines. In general the surface in this portion of the department presents strong deep wheat soils, rich pastures, vineyards, and orchards; there are, however, some barren wastes here as well as north of the Loire, but they are comparatively of small extent. Large tracts are covered with heath and broom (*genêt*), the latter the plant which, it is said, originated the name of our great English dynasty of Plantagenet. The inundations of the rivers add greatly to the fertility of the soil. The climate generally is mild.

Products.—The valleys of the Loire and the other principal rivers in this department contain some of the most productive and best cultivated land in France. All kinds of breadstuffs are produced in quantity more than enough for the consumption. One of the most important products is wine, of which 14,000,000 gallons are made in ordinary years; next come hemp, walnuts for making oil, plums, beans, leguminous plants, liquorice, anise, and coriander; citrons, melons, almonds, apples, pears, truffles, &c. Bees and silkworms are carefully tended; game and fish are abundant.

Iron mines are worked; stone, especially a tufaceous sandstone, of which most of the houses are built, is quarried out of the hills near the Loire, and excavations thus formed are occupied as dwelling-places by the poorer inhabitants. Millstone grit, marl, lithographic stones, pipe and potter's clay, and brick-earth are found. Copper ore is met with, but no mines are worked.

The chief industrial products are bar iron, powder, and files; woollen cloth, of which manufacture Tours is the centre; silk, leather, paper, and pottery are also made, but the manufacture of the three latter articles is not so important as formerly. The culture of silk is increasing, as are the silk, linen, and woollen manufactures of Tours. There is a national gunpowder factory and nitre refinery at Montbazon. About ninety fairs for the sale of cattle and agricultural produce are held. Druidical or Celtic remains are numerous in this part of France.

The department is divided into the three arrondissements of Tours, Chinon, and Loches. The town of TOURS is the capital of the department.

IN'DRIS is a genus of lemurs, the type of the Indrisinæ, a subfamily of Lemuridæ. In the Indrisinæ there are only thirty teeth in the adult, but in the milk dentition there are four additional teeth in the lower jaw, which are not replaced. The Indris are peculiar to Madagascar. They are all slender animals, with very long legs. The tail is quite rudimentary in the typical genus Indris, but very long in the other genera. The great toe (*hallux*) is large and very opposable; the other toes of the hind foot are united by a fold of skin which extends to the first joint. The stomach is single, the cæcum is very large, and the large intestine very long and spirally coiled, indicating the vegetarian habits of these animals. The Indris are exclusively arboreal, being rarely seen on the ground. Among trees they display great agility and grace in climbing, running, and jumping. They are usually nocturnal in their habits. Three genera have been described, Indris, Propithecus, and Avahis. The species are not numerous. The Short-tailed Indris (*Indris brevicaudatus*) has the tail a mere stump, only about 2 inches in length. This species is the largest of the lemurs, measuring a little over 2 feet in length. Its fur is very soft, long, and thick. Its general colour is black, marked with white hairs on the throat, forearm, and buttocks. It is said to be of a mild and gentle nature. The natives of Madagascar train it to hunt for birds. The Diadem Indris (*Propithecus diadema*) has a long bushy tail and short ears concealed by the hair of the head. The fur is white, forming a kind of crown or diadem on the top of the head. These lemurs display the greatest activity in the morning and the evening.

They are found in bands in the dense forests of Madagascar feeding on buds, flowers, and berries. The Woolly Lemur or Avahis (*Avahis laniger*) is a small species, about 15 inches in length; the long bushy tail is only an inch shorter. It is strictly nocturnal, and is met with alone or in pairs. Its characteristics are—hind limbs extremely long, and hind thumbs of extraordinary size; fur peculiarly soft, delicate, and curly, finer than wool; ears small, round, and buried in the fur; colour, rusty brown gray, the hairs of a leaden tint at the base; face, brighter red brown; on the knees and forearms a decided tinge of red brown; throat, chest, and abdomen, gray; a spot on the haunches over the hip-joint and the back of the thighs white; tail round, bright rufous or chestnut red.

INDUC'TION, as defined by the late Archbishop Whately, "is a kind of argument which infers respecting a whole class what has been ascertained respecting one or more individuals of that class." According to Sir William Hamilton, the word has been employed to designate three very different operations:—(1) the objective process of investigating particular facts as preparatory to induction, which he observes is manifestly not a process of reasoning of any kind; (2) a material illation of a universal from a singular, as warranted either by the general analogy of nature or the special presumptions afforded by the object-matter of any real science; (3) a formal illation of a universal from the individual, as legitimated solely by the laws of thought and abstracted from the conditions of any particular matter. The second of these operations is the inductive method of Bacon, which proceeds by means of rejections and conclusions, so as to arrive at those axioms or general laws from which we may infer by way of synthesis other particulars unknown to us, and perhaps placed beyond reach of direct examination. ("Nov. Org.," "Aph.," c. iii. c. v.) Aristotle's definition coincides with the third, that induction "is an inference drawn from all the particulars." ("Prior. Analy.," ii. c. xxiii.) The third alone is properly the induction of logic; for logic does not consider things, but the general forms of thought under which the mind conceives them; and the logical inference is not determined by any relation of causality between the premise and conclusion, but by the subjective relation of reason and consequence as involved in the thought. The inductive process is exactly the reverse of the deductive; for while the latter proceeds from the whole to the part, the former ascends from the part to the whole; since it is only under the character of a constituted or containing whole, or as a constituent and contained part, that anything can become the term of logical argumentation. Of these two processes Sir William Hamilton gives the following figures:—

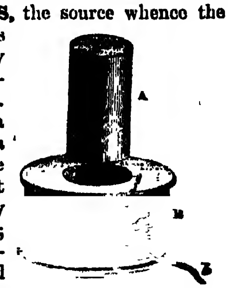
Induction.	Deduction.
X Y Z are A,	B is A,
X Y Z are whole B,	X Y Z are under B,
∴ whole B is A.	∴ X Y Z are A.
Or,	Or,
A contains X Y Z,	A contains B,
X Y Z contains B,	B contains X Y Z,
∴ A contains B.	∴ A contains X Y Z.

But it is to John Stuart Mill that we owe the grand development of the inductive logic as an arm of research which has really given induction its full force. He shows ("Logic," book iv.) that induction, or the search after causes and effects, can be undertaken by four methods, respectively entitled the methods of *agreement*, of *difference*, of *residues*, and of *concomitant variations*. These cannot be stated in any other words so forcibly or so tersely as his own.

Mill defines the method of (1) *agreement* thus: "If two or more instances of the phenomenon under investigation have only one circumstance in common, the circumstance in which alone all the instances agree is the cause or effect of the given phenomenon." In this way, if we have sufficient instances to exclude other disturbing forces, we may from the consideration of these derive a universal law. This is the aim of induction, to infer the universal from the particular. The method of agreement often fails because enough instances are not procurable, or because the phenomenon is not able to be isolated, the instances all agreeing in several things as well as in the phenomenon in question. The second method, the method of (2) *difference*, which requires only two instances, is therefore found to be the more useful in practice. Mill's canon of difference is this: "If an instance in which the phenomenon under investigation occurs and an instance in which it does not occur have every circumstance except one in common, that one occurring only in the former, the circumstance in which alone the two instances differ is the cause or effect or a necessary part of the cause or effect of the phenomenon." The valuable method of (3) *residues*, which as a matter of fact is the great inductive weapon of scientific research of to-day, is described by its author as follows: "Subduct from any (complex) phenomenon such part as is known by previous induction to be the effect of certain antecedents, and the residue of the phenomenon is the effect of the remaining antecedents." But supposing there is a cause constantly present and impossible to be isolated, such as gravitation, or as the presence of matter in some form, however attenuated, in what we call a *vacuum*, &c., then Mill employs the fourth method for estimating the effect of such a cause, namely, the method of (4) *concomitant variations*. By watching how the cause varies we can see if the phenomenon varies with it, and if so we can connect them as cause and effect. This is the rule: "Whatever phenomenon varies in any manner whenever another phenomenon varies in some particular manner, is either a cause or effect of that phenomenon, or is connected with it through some fact of causation."

Having by one or more of these inductive methods obtained from many instances collected by observation a conclusion or hypothesis larger than our premises, it is our duty to test the accuracy of that conclusion by the converse agency of deduction. Our general principle being stated we deduce from it a particular instance, and then test it to see whether the expected effect is produced. In this proof, which is called *verification*, we assume the uniformity of nature, and that is an assumption which rests upon so long-continued a series of observations, covering the whole history of man, that we may reasonably take it for granted as a fact. The three stages in scientific discovery are therefore observation, hypothesis (by induction), verification (by deduction), and without all these three, each in its due order, scientific advance is for ever impossible.

INDUCTION CURRENTS, the source whence the electric *induction coil* derives its power, are a discovery of Faraday in 1831. At first only magneto-electric induction was known. Faraday discovered that if a magnet, A, be plunged into a coil of insulated wire B, whose ends *a b* are connected in circuit with a galvanometer, a momentary electric current will be produced; and an equally momentary current in the reverse direction will be produced by its withdrawal. The same results are produced if it is the coil which moves towards or from a stationary magnet; and in each case the more rapid the motion the stronger the momentary current.



Magneto-Electric Induction.

Later on Faraday found that a similar effect was obtainable from a current of electricity; that is to say, a current flowing round a long coil of wire (called the *primary coil*) will induce a momentary current in the opposite direction in a larger *secondary* coil, into which it is plunged; and on withdrawing it, just as in the case of the magnet, this momentary current is repeated, but reversed, that is to say it is now in the same direction as the primary current. In other words, the induced current on the secondary when the primary coil is inserted is *inverse*, and that induced when the primary is withdrawn is *direct*. But it was soon found that it is not necessary to move the primary in and out of the secondary coil, if while it lies at rest within it the current be broken and then remade; for breaking the circuit has the same result as withdrawing the primary, and making the circuit again has the same result as inserting it; breaking the circuit induces a momentary direct current, making it induces a momentary inverse current. The powerful *induction coil* of Mason, as developed by Ruhmkorff, depends on these principles. A cylindrical bobbin with a central iron core has wound upon it a short inner or primary coil of stout wire, and outside this is the secondary coil of many thousand yards of fine insulated wire. The primary is joined up with a powerful battery, the current passing through a piece of mechanism called an *interruptor*, which is self-acting and continually makes and breaks the circuit. The interruptor of Foucault has a centred metal arm, a point at one end of which dips into a cup of mercury and so makes the circuit; but on the other end being attracted by the magnetized core of the primary, the point is withdrawn from the mercury and the circuit broken. This, however, demagnetizes the core, the attraction of the near arm ceases, and gravity (or a spring) causes the point on the further arm once more to fall into the mercury and effect contact. A more usual contrivance for small coils is a piece of thin steel spring, which, being drawn aside from contact when the core is made a magnet, thus breaks the circuit; the magnetization instantly ceasing, the steel returns to contact by its own elasticity and remakes the circuit. Thus it continues to vibrate to and fro in a most rapid manner. The primary coil is of stout wire to carry strong currents and produce a strong magnetic field, and is of few turns to keep the resistance low and to avoid self-induction. The central core increases the number of lines of force passing through the coils by its large coefficient of magnetic induction. In order to avoid the induction currents which circulate in a solid bar this core is frequently made of a bundle of fine wires, with great advantage to the rapidity of magnetization and demagnetization. The large number of turns and the great length of circuit of the secondary coil provide for a large coefficient of mutual induction; and as the electro-motive force mounts up to many thousand volts, the resistance is immaterial, and the finest wire procurable may be used. In working the induction coil the inverse currents which yield no spark, and which are produced at "make," are suppressed by suitable means, and the currents at "break" appear as a brilliant series of sparks and loud crackling detonations when the ends of the wires of the secondary coil are brought near one another. The immense power obtainable may be gathered from the fact that the president of the Royal Society, Mr. Spottiswoode, with thirty Grove cells on the primary coil produced a spark of 42½ inches long in air. In this great machine the secondary coil contained 280 miles of wire, wound in 340,000 turns, and giving a resistance of 100,000 ohms.

The word *induction* as here used in "induction currents" must be carefully distinguished from the *induction charges* of frictional electricity. A charge of electricity always induces or generates upon neighbouring conductors an equal electrical charge of the opposite kind. A primary positive charge will thus induce an equal secondary negative charge on another conductor or a neighbouring surface of the same conductor. See the article ELECTRICITY, paragraph *induction*.

INDUL'GENCE is a power claimed by the Roman Catholic Church of granting to contrite and confessed sinners a remission of the temporal punishment which often remains due to sin after its guilt has been remitted. In the primitive church all members who were guilty of any grievous crime, such as adultery, apostasy, or murder, were cut off from communion with the church, and if they sought readmission they were compelled to pass through a long period of penance—a period which sometimes extended until the hour of death. The time required for an ordinary course of penance extended to some years, and hence there arose a disposition on the part of the bishops to remit a portion of the sentence in the case of those who were truly penitent. This practice was defended by a reference to the remission granted by the apostle Paul to the offender at the church of Corinth (1 Cor. v. 5 and 2 Cor. xi. 10), and it was confirmed by the decisions of the Council of Ancyra in 308 and that of Nice in 325. Three centuries later we find a practice that had grown up in the interval of purchasing this indulgence by gifts to the poor or to the church, receiving sanction and being regulated in the "Penitential" of the Greek Theodore of Canterbury (668–690), which prescribes a graduated series of fines as a means of redeeming penance. At the time of the Crusades a plenary indulgence was granted to all who took part in them; and finally, by the schoolmen the doctrine was elaborated, that while after sin has been pardoned it must receive temporal punishment or be expiated in purgatory, yet merit might be substituted, and that from the treasury of merit earned by the saints and martyrs the church could at all times draw sufficient to remit such a penalty wherever the sinner truly repented of and confessed his sin, and firmly purposed amendment. From the abuse of this doctrine there arose a series of practices of the most objectionable character. The matter reached its height under the pontificate of Leo X., who, being in need of money to build St. Peter's at Rome, offered indulgences to all who contributed. Albert, archbishop of Mainz and Magdeburg, selected to preach these indulgences the Dominican monk Tetzel of Leipzig. Tetzel's appointment and his preaching aroused the indignation of Luther, who drew up and fastened on the church door at Wittenberg a series of ninety-five propositions, in which he denounced the abuse of indulgences, while pronouncing anathema on all who denied their value, October, 1517. The doctrine relating to indulgences was regulated and restated by the Council of Trent, and all modern Roman Catholic legislation on the subject is based upon these decrees.

An indulgence, according to the Roman Catholic catechism, is not in any sense a pardon of the guilt of sin, whether past, present, or future; but it always supposes that the guilt has already been removed by sincere repentance before its benefit can be applied to the soul. There are two kinds of indulgences—plenary and partial. By a plenary indulgence is meant the remission of the whole debt of temporal punishment due to sins, and by a partial indulgence a part of that debt. If, for instance, a man had gained for his own benefit a plenary indulgence, he would go straight to heaven without passing through purgatory; but if he had only gained a partial indulgence, he would have to expiate the rest of his debt in purgatory. An indulgence being the remission of the temporal punishment which remains *after* the guilt has been remitted, necessarily presupposes a state of grace. Nay, so perfect must be this condition in the case of a plenary indulgence, that it requires a freedom from the guilt not only of mortal but also of venial sin. For so long as there remains on the soul the least venial sin unforgiven, the temporal punishment due to

that sin cannot be remitted, and consequently the full benefit of a plenary indulgence cannot be obtained. Protestants generally regard the doctrine of indulgences as being founded not only on an unwarranted assumption of power given to the church, but also on a doctrine of human works and merits inconsistent with what Scripture teaches as to the office of Christ as a Saviour.

INDURA'TION OF STRA'TA. See article METAMORPHISM.

IN'DUS (Sanskrit, *Sindhu*; Greek, *Sinthus*; Latin, *Sindus*), one of the three great rivers of Northern India. It rises in an unexplored region on the northern slopes of the sacred Kailas Mountain (summit, 22,000 feet), the Elysium of ancient Sanskrit literature. On the south of the same hill rises the Sutlej, the great feeder of the Indus, which unites with it after a separate course of about 1000 miles. The Indus rises in lat. 32° N. and lon. 81° E., enters the Punjab (Panjab) in lat. 34° 25′ N. and lon. 72° 51′ E., leaves the Punjab in lat. 28° 27′ N. and lon. 69° 47′ E., enters Sind in lat. 28° 26′ N. and lon. 69° 47′ E., and finally falls into the Arabian Sea in lat. 23° 58′ N. and lon. 67° 30′ E. The drainage basin of the Indus is estimated at 372,700 square miles, and its total length at a little over 1800 miles.

The first section of the course of the Indus lies outside British territory. It takes its rise in Tibet behind the great mountain wall of the Himalayas, which forms the northern boundary of India. It at first flows north-west for about 160 miles under the name of Sinh-ka-bab, until it receives the Ghar River on its south-western bank. A short distance below this junction it enters Cashmere, and continues north-west to Leh, where it is crossed by the great trade route into Central Asia *via* the Karakoram Pass. The Indus is supposed to have an elevation of 16,000 feet at its source. Shortly after it passes the Cashmere frontier, it drops to 14,000 feet, and at Leh is only about 11,278 feet above the level of the sea. The rapid stream dashes down gorges and wild mountain valleys, and is subject to tremendous floods. Indeed, even in summer it sometimes dwindles down to a fordable depth in in the night, and during the course of the day swells into an impassable torrent from the melting of the snows on the adjoining heights. The wonderful gorge by which the river bursts through the western ranges of the Himalayas is nearly 14,000 feet in sheer depth.

The Indus, on entering the Punjab, 812 miles from its source, is about 100 yards wide in August, navigable by rafts, but of no great depth, and studded with sandbanks and islands. It is fordable in many places during the cold weather; but floods or freshets are sudden, and Ranjit Sinh is said to have once lost a force, variously stated at from 1200 to 7000 horsemen, in crossing the river. Even the large and solid ferry-boats which ply upon it are sometimes swept away. A little way above Attock, in Rawal Pindi District, it receives the Kabul River, which brings down the waters of Afghanistan. The two rivers have about an equal volume, both are very swift and broken up with rocks. Their junction during floods is the scene of a wild confusion of waters. The Kabul River is navigable for about 40 miles above the confluence, but a rapid just above it renders the Indus impracticable.

Attock forms the first important point on the Indus within British territory; it is 860 miles from the source, and 940 miles from the sea. The river has fallen from its elevation of 16,000 feet at its source in Tibet to under 2000 feet, the height of Attock being 2079. In the hot season, opposite the fort, its velocity is 13 miles an hour; and in the cold season, 5 to 7 miles. The rise of ordinary floods is from 5 to 7 feet in twenty-four hours only, and the maximum is 50 feet above cold-weather level. The Indus is crossed at Attock by a bridge of boats and a ferry and a railway bridge.

After leaving Attock, the Indus flows almost due south along the western side of the Punjab, parallel to the Suliman Hills. Just above Mithankot, in the south of Dera Ghazi Khan District, the Indus receives the accumulated waters of the Punjab. Between the Indus and the Jumna (Jamuna) flow the five great streams from which the Punjab (Panj-ab, literally, "the land of the five waters") takes its name. These are the Jhelum, the Chenab, the Ravi, the Beas (Bias), and the Sutlej (Satlaj). After various junctions, these rivers all unite to form the Panjnad, literally, "the five rivers." The Panjnad marks for a short space the boundary between the Punjab and Bahawalpur state, and unites with the Indus near Mithankot, about 490 miles from the sea. The breadth of the Indus above the confluence is about 600 yards, its velocity 5 miles an hour, its depth from 12 to 15 feet, and its estimated discharge 91,719 cubic feet per second. The breadth of the Panjnad above the point of junction is 1076 yards, with an equal depth of 12 to 15 feet, but a velocity of only 2 miles an hour. Its estimated discharge is 68,955 cubic feet per second. Below the junction, the united stream, under the name of the Indus, has a breadth which varies from 2000 yards to several miles, according to the season of the year. The whole course of the Indus through the Punjab is broken by islands and sandbanks. From this point the Indus forms the boundary between the Punjab and Bahawalpur state, until it enters Sind in lat. 28° 26′ N., and lon. 69° 47′ E. Finally, it empties itself by many mouths into the Arabian Sea, after a generally south-westerly course in that province of 580 miles. It ranges in width from 480 to 1600 yards, the average during the low season being 680 yards. During the floods it is in places more than a mile in width. Its depth varies from 4 to 24 feet. The water, derived from the snows of the Himalayas, is of a dirty brown colour, and slightly charged with saline ingredients, carbonate of soda, and nitrate of potash. Its velocity in the freshets averages 8 miles per hour, at ordinary times 4 miles. The discharge per second varies at the two periods from 446,086 cubic feet to 40,857. On an average, the temperature of the water is 10 degrees lower than that of the air.

The delta of the Indus covers an area of about 3000 square miles, and extends along the coast-line for 125 miles. It is almost a perfect level, and nearly destitute of timber, the tamarisk and mangrove alone supplying fuel. In the marshy portions good pasturage is obtained, and rice grows luxuriantly wherever cultivation is possible. The climate is cool and bracing in the winter months, excessively hot in the summer, and during the floods most unhealthy. In 1800, the Indus at the apex of the delta divided into two main streams, known as the Baghiar and Sita; but in 1837 it had entirely deserted the former channel. The following facts illustrate further the shifting nature of this river. In 1845, Ghorabari, then the chief commercial town of the delta, was on the river bank; but in 1848 the river deserted its bed. Upon this, the town of Keti was built on the new bank. This, however, was overflowed a few years later, and a second Keti had to be built further off. At present one of the chief obstructions to navigation is a series of rocks between Tatta and Bhiman-jo-pura, which in 1846 were 8 miles inland. Otters, turtles, and crocodiles are numerous.

The entire course of the Indus in British territory, from Attock to the sea, lies within the zone of deficient rainfall, the annual average being nowhere higher than 10 inches. Cultivation, therefore, is absolutely dependent upon artificial irrigation, almost to as great an extent as in the typical example of Egypt. But the Indus is a less manageable river than the Nile. Its main channel is constantly shifting; and during the season of flood, the melted snows of the Himalayas come pouring down in an impetuous

torrent which no embankment can restrain. From time immemorial this annual inundation has been utilized as far as possible by an industrious peasantry, who lead the water over their fields by countless artificial channels. Many such channels, constructed in the old days of native rule, extend 30 and even 40 miles from the river bank. As a channel of navigation the Indus has disappointed the expectations that were at one time formed. Before British arms had conquered Sind and the Punjab, it was hoped that the fabled wealth of Central Asia might be brought by this course down to the sea. But, even so far as local traffic is concerned, experience has proved in this case, as with most other Indian rivers, that the cheapness of water communication cannot compete with the superior speed and certainty of railways. Since the opening of the Indus Valley State Railway in 1878, navigation on the Indus, whether by steamer or by native boat, has fallen off.

INDUSTRIAL SCHOOLS are institutions holding an intermediate position between the voluntary ragged schools and the reformatories for juvenile criminals. They have to be certified by government, and are supported by means of grants from the Treasury, payments from rates, subscriptions, and legacies, and the profit on the industrial department of their work. They are regulated by the provisions of the Industrial Schools Act passed in 1866, by which all previous legislation was consolidated, and the operation of this Act was extended to Ireland in 1868. By this Act magistrates are empowered to send to a certified industrial school any children under fourteen found begging; refractory children under fourteen in workhouses and pauper schools; refractory children under fourteen in charge of parents; and children under twelve charged with offences against the law. In the schools the inmates are fed, clothed, educated, and instructed in some occupation by which they may earn their own livelihood. The trades taught comprise tailoring, shoemaking, brushmaking, boxmaking, and firewood cutting. By the Education Act of 1870 for England, and the corresponding Act of 1872 for Scotland, power was given to the school board of any parish or borough to establish and maintain industrial schools subject to the provisions of the Industrial Schools Act of 1866.

I'NE, called also **INA,** King of Wessex, was the son of Cenred, king of Wessex. Ceadwalla, the usurper, who had seized the kingdom, became converted to Christianity, gave up his crown in 688, made a pilgrimage to Rome, was there baptized by the name Peter by Pope Sergius, and fell sick and died while yet his white robes of penitence were on him, A.D. 689. Ine had succeeded to the crown, though King Cenred was still living, as we know from the famous collection of laws which he published in the fifth year of his reign, which are stated in the introductory paragraph to have been enacted with the advice of Cenred and other counsellors. These laws of Ine, to quote the summary of Dr. Lingard, "regulated the administration of justice, fixed the legal compensation for crimes, checked the prevalence of hereditary feuds, placed the conquered Britons under the protection of the state, and exposed and punished the frauds which might be committed in the transfer of merchandise and the cultivation of land." It is the oldest Wessex code we have, and the oldest of all save the Kentish laws of Ethelbert. The administration of Ine was wise and vigorous, and he waged successful wars with several of his neighbour potentates. The closing years of his reign were, however, disturbed by several rebellions, which were not suppressed without a lengthened struggle and no little bloodshed. In 726 Ine in his turn resigned his crown and retired to Rome, where he died.

INEQUALITY, in astronomy. For the sake of convenience the average motion of a planet or satellite, supposed to be made in a circle which has the average distance of the body from the sun or primary for its radius, is the first object of calculation when the place of the body at some future time is to be predicted. All the alterations which are rendered necessary by the unequal motion of the planet are called inequalities. If they are of such a nature as to become apparent only after a considerable lapse of time, they are called secular inequalities.

INER'TIA. This word means something equivalent to the modern English sense of inactivity, and expresses that universal property of matter by which it does not change its state either of rest or motion unless acted upon by some external force. The former part of this principle was known to the ancients, but Galileo demonstrated that the latter was equally true and general. This property of matter has been called by Kepler *vis inertiæ*. It is this inertia of motion which throws us forward (or backward, according to which side of the carriage we are sitting) when a train suddenly stops, or which flings us down upon the platform if we carelessly step from a train still moving, the feet being checked by the platform while the head and body travel forwards by the inertia gained in the moving train. In the same manner a rider is thrown over the neck of a horse which stops dead in full career. Use is taken of this property of matter in leaping, sliding, &c., when a start or run is taken in order to acquire sufficient inertia of motion to carry us forward as we desire. This brings us to the greatest mechanical use of inertia—namely, the use of heavy fly-wheels to equalize the motion of machines. It is also inertia which permits a card to be flicked from beneath a coin, leaving the coin to fall into the glass below; or which accounts for a door which the slightest push will open being perforable by a rifle shot without stirring. In this latter case time is not given for the inertia of the door to be overcome. That is why very rapid explosives (nitroglycerine, &c.) cannot be used in firearms; they burst the piece before they have time to overcome the inertia of the projectile.

INFALLIBIL'ITY OF THE CHURCH. The Church of Rome claims to be infallible in her teaching as to faith and morals, asserting that she is assisted by the Holy Spirit in understanding the extent and meaning of the revealed truth of God, so that she cannot propose any doctrine as true which is false, nor condemn any doctrine as evil which is in reality good. Roman Catholics base this claim on several passages of Scripture, but most especially on those which occur in Matt. xvi. 18; xxviii. 20; Luke xiv. 31, 32; and John xiv. 16. They also argue that it is absolutely necessary for the church to be infallible, or otherwise there could be no safety as to the truth or falsehood of any new doctrine which might be proposed. Catholics have always agreed that the power of infallibility resided in the collective decisions of the bishops of the church, acting with the pope, when assembled as a general council; but for many ages differences of opinion existed as to whether the pope himself was infallible. As a private individual, it was admitted by all that the pope was liable to the failings and errors of other men; but it was claimed for him in his official capacity, that whenever, formally as pope, he addressed to the whole church instruction in matters of faith or morals he was preserved by the Holy Spirit from teaching error, and that this gift of inerrancy, bestowed for the good of the church upon the pope as her supreme visible teacher, existed in him independently of the adhesion to his teachings of the bishops assembled in council. Some theologians, however, especially of the French school, held that inerrancy in teaching did not reside in the pope alone, and that the assent of the bishops, either assembled in council or dispersed throughout the church, was needed to make the papal teaching infallible. To settle this point the Œcumenical Council of 1869–70 (the first for more than 300 years) was assembled at Rome, and after a long discussion of the subject they agreed to the following propositions:—

1. If any one shall say that the episcopal chair of the Roman Church is not the true and real infallible chair of Blessed Peter, or that it has not been divinely chosen by God as the most solid, indefectible, and incorruptible rock of the whole Christian Church, let him be anathema.

2. If any one shall say that there exists in the world another infallible chair of the truth of the gospel of Christ our Lord, distinct and separate from the chair of Blessed Peter, let him be anathema.

3. If any one shall deny that the divine *magisterium* of the chair of Blessed Peter is necessary to the true way of eternal salvation for all men, whether unfaithful or faithful, whether laymen or bishops, let him be anathema.

4. If any one shall say that each Roman pontiff, legitimately elected, is not by divine right the successor of Blessed Peter, even in the gift of the infallibility of *magisterium*, and shall deny to any one of them the prerogative of infallibility for teaching the church the word of God pure from all corruption and error, let him be anathema.

5. If any one shall say that general councils are established by God in the church as a power of feeding the divine flock in the word of faith superior to the Roman pontiff, or equal to him, or necessary by divine institution, in order that the *magisterium* of the Roman bishop should be preserved infallible, let him be anathema.

The Greek Church claims infallibility for the decrees of the councils which she looks upon as œcumenical, and inerrancy, or actual exemption from error, for her teaching up to the present time. The Protestant churches have never admitted the doctrine of infallibility.

IN'FANGTHEOF or **INFANGENTHEOF**, the right of criminal jurisdiction frequently granted in early English times to holders of large estates, along with other legal privileges, as *sac*, power of fining; *soc*, jurisdiction over a district; *tol*, marked rights over the district; and *team*, the right of search for presumably stolen goods. In such comparatively lawless times a strong nobleman was of great value with his private law-courts, in this way aiding to preserve the peace of the kingdom. Eventually, however, the later Norman kings found this a source of evil, weakening the royal power, and it was gradually abandoned. It did not entirely disappear until the Wars of the Roses had reduced the great houses, and rendered it possible for Henry VII. finally to gather up all power and jurisdiction into the hands of the crown.

INFANT, a person under the age of twenty-one. He has various privileges and disabilities. An infant cannot be sued, as a general rule, save under the protection and joining the name of his guardian, that is, his guardian *ad litem*, appointed by the court for the purpose of the particular suit; and on the other hand they may sue by their next friend. The exception to this rule is made by the County Courts Act, where an infant may sue for wages not exceeding £20; he may bind himself to pay for his necessary meat, drink, apparel, physic, and such other necessaries, and for his good teaching and instruction; and in determining what are necessaries regard is had to the infant's degree or station in life. He is also liable for such necessaries as are supplied to his wife and family, but not for goods supplied to him while living unmarried under the roof of his parent. Infants lose nothing during their minority by non-claim or neglect of demanding their rights. They cannot make any conveyance or purchase that will bind them, nor enter into a binding contract, nor do any legal act, nor hold any public office of pecuniary trust, or any office of a judicial kind; but a contract entered into during infancy is voidable rather than void, because it may be confirmed by the infant when he becomes of age; and again, he may always act as the agent for another person, and may bind himself apprentice, and he may present, having an advowson, to the benefice when it becomes void. In criminal cases a person of the age of fourteen years may be capitally punished for a capital offence, but under the age of seven he cannot. At fourteen he may enter into a binding marriage, and a female may do so at twelve years of age, if they can obtain the consent of their parents or guardians. An infant is also answerable in an action brought against him for slander, battery, or trespass on land.

In Scots law the word infant is used in its popular sense only. To describe persons in nonage the Roman law terms "pupil" and "minor" are employed. Pupillarity in girls lasts till twelve years of age, in boys till fourteen. In both sexes minority ends at twenty-one. A pupil can neither sue nor be sued without his guardian, termed his "tutor," being a party to the action. A minor may sue or be sued in his own person if he has no guardians, styled in his case "curators;" but the court will generally appoint a *curator ad litem*. In other respects the law of Scotland, notwithstanding the differences in terminology, is practically the same as that of England in all that regards the rights of persons in nonage.

An *infant* in Roman law was a person *in-fans*, not speaking or allowed to speak (Lat. *fari*, to speak). Such not-speaking persons, or *infantes*, were children up to seven years of age, whether male or female. Then, still remaining *impuberes*, they were "speaking" children *(qui fari possunt)* up to twelve if girls, fourteen if boys. From these ages they remained minors up till twenty-five (*minor*, less; less, that is, than twenty-five years old), their legal title being *adolescentes*, or youths, during this third stage of minority. Majority began at twenty-five, when the *minores* became *majores*. Both youths and majors were accounted *puberes* or full-grown. These distinctions were made with reference to the Roman law, which incapacitated the younger of these classes from certain legal acts. *Impuberes* were always under the charge of a tutor (the father if he was living), who was their legal representative; and *adolescentes*, or minors beyond the age of childhood, though emancipated from their tutor, were yet subjected to a *curator* or guardian by the Lex Plaetoria. Though capable of legal action, he had to sue and be sued through his guardian (usually his father) up till the age of twenty-five. Hence is derived our legal plea of infancy against exorbitant charges or heavy expenses brought against youths' estates. Our majority is, however, at twenty-one, the Roman's was at twenty-five.

INFAN'TA, INFAN'TÉ, the titles of the princesses and princes of the royal houses of Spain and Portugal. The latter is seldom used, as the heir-apparent to the throne in Spain is styled Prince of Asturias, and the heir-apparent in Portugal was styled Prince of Brazil till the separation of that country from Portugal in 1822.

INFAN'TICIDE. The practice of putting infants to death or exposing them has existed from the earliest ages. The exposure of infants was common to all the Grecian states, with the exception of Thebes; and among the Romans prevailed from the time of Romulus to that of Valentinian I. We have proof of the existence of the practice of putting infants to death among the Persians, Phœnicians, Carthaginians, Peruvians, and Mexicans. In China, throughout almost every part of the empire, a large proportion of the female population are put to death as soon as they are born. One traveller, Mr. Abeel, states that in some provinces not one female infant out of three is suffered to live; and that in others the difference between the male and female population is one to ten. Lord Macartney estimated the annual mortality in Pekin at 20,000; while Gibbon, on the authority of Le Comte, limited it to 3000. Among the Hindus, from the difficulty of providing marriage portions for their daughters, the custom, which had existed for 2000 years, prevailed to a very great extent, till the Marquis of Wellesley, when governor-general of India, used every possible exertion to

put a stop to it. His efforts, however, were only temporarily successful, and female infanticide was shown by the census results of 1872 to be still extensively prevalent in many of the tribes of the outlying districts. Since that time the very strict and careful efforts of the authorities have reduced the practice to extremely small limits. During the middle ages it is stated by the Jesuit Gaspar Vilela to have existed in Japan, but at the present day it has much decreased. Among the Mohammedans the practice is not discountenanced, though greatly lessened by the habit of producing abortion. Strabo tells us that it was unknown to the ancient Egyptians, and Tacitus says the same of the Germans. No traces of it have as yet been discovered among any of the early British tribes. It has been found among the native septs of Brazil, in Otaheite, the South Sea and Sandwich Islands, to a fearful extent; also in New Zealand, New South Wales, South Africa, and even in Hudson Bay Territory, Labrador, and Iceland.

Among the ancient and heathen nations infanticide appears as a practice, not as a crime. In the countries again where Christianity prevails, child-murder has ever been regarded with the deepest abhorrence, and visited with the extreme severity of the law. Among the Germanic nations of the middle ages the punishment of death was appended to the murder of a new-born child, and the same rule held good in Lombardy and Saxony. In France a well-known Act of Henry II., passed in 1556, punished with death, as presumably guilty of the murder of her child, every woman convicted of concealment of pregnancy. This law prevailed till 1791, when this very unjust presumption was repealed; but the punishment of death still continued for the murder of the child. The statute of Henry II. was adopted in England by the 21 Jac. I. c. 27, and by 6 Anne, c. 4, was extended to Ireland. Both of these were afterwards rescinded, and the law is now fixed by 24 & 25 Vict. c. 100. s. 60. The alterations which this Act made on the law may be said to consist in this: that while the old law from an accusation of concealment of birth could deduce a charge of murder, the modern law can only deduce the charge of concealment of birth from an accusation of murder. In Scotland the law, after passing through variations similar to that of England, may now, with certain technical differences, be said to be the same as in the sister country. The Act 1690, c. 21, was in all respects identical with the 21 Jac. I. c. 27. The existing statute is 49 Geo. III. c. 14, by which concealment of pregnancy is punishable with imprisonment for a period not exceeding two years, while the putting to death of an infant child still remains murder at common law. A large proportion of the murders committed in England falls under this head; and much the same must be said of other modern nations. A recent traveller relates that in the penitentiary for women at Prague, of the 400 women confined there 130, or 32½ per cent., had been convicted of child-murder. It is one of the most difficult questions of medical jurisprudence, from the ease with which infant life may be destroyed, to establish the murder of a child lately born. The chief points for decision are—(1) whether the infant, the subject of inquiry, was born dead or alive; and (2) whether its death was the result of violence or of natural causes. If the former, the offence is murder. There are institutions in this country, as well as in many other European countries, which have been founded with the view of restraining infanticide; and in consequence of the revolting disclosures made in some cases of "baby farming," the Infant Life Protection Act was passed in 1872, under which no one is allowed to receive for hire or reward more than one child, except in a house which has been duly registered, and is open to the inspection of the local authorities.

IN'FANTRY is a name given to soldiers who serve on foot. Among the ancient nations of Europe the foot soldiers constituted the chief strength of the armies. In the best days of the Grecian and Roman states battles were mainly won by the force and discipline of the phalanges and legions, and the number of the infantry in the field far exceeded that of the cavalry. The ancient Franks fought on foot; and, in this country, the greater part of the Anglo-Saxon forces consisted of infantry. But soon after the time of Charlemagne the institutions of chivalry began to be generally adopted in the kingdoms of Europe; and by degrees the cavalry, which was composed of persons possessing rank and property and completely armed, acquired the reputation of being the principal force in war; the foot soldiers, ill armed and disciplined, were held in comparatively small estimation.

The infantry of this country, for some time after the Conquest, consisted of the yeomanry, vassals, and dependants of the feudal tenants; and occasionally foot soldiers were engaged by the kings, under indentures, to serve in the wars. Louis XI. of France formed a standing army of 10,000 French infantry, to which were joined 6000 Swiss; and subsequently Charles VIII. added a large body of Lansquenets, or German infantry. The reputation of the native troops in France was then at a low ebb, but the Swiss soldiers were inured to discipline; they were protected by defensive armour and formed into deep battalions, in which state they were able to render the shock of cavalry entirely unavailing

The Spanish soldiery, probably from being almost constantly engaged in warfare with the Moors, had early acquired considerable reputation; and, subsequently, the great share which it had in the wars carried on both in Italy and Flanders, its steady discipline, and the success which resulted from the association of musketeers with pikemen in the battalions, caused the infantry of Spain to be considered, during many years, as the best in Europe. To this state of excellence it was mainly brought by the labour and genius of Gonzalo de Cordova, styled the Great Captain. England, France, and Germany soon adopted the improvements introduced by the Spaniards; and it may be added that the practice of keeping up standing armies composed of men trained in the art of war under a rigid system of discipline, together with the universal adoption of the musket, has now brought all the infantry of Europe to nearly the same degree of perfection.

In the United Kingdom great attention has of late years been paid to the improvement of this arm of the service; and by the establishment of schools of musketry at Hythe, Fleetwood, and elsewhere, some efforts have been made to instruct the infantry in the use of the weapons of precision with which they are armed. It is to be regretted, however, that more attention is not paid to this all-important part of a soldier's training, and that some of the improved methods of teaching known and practised on the Continent should be neglected by the authorities. The social condition of the soldiers has also been ameliorated; their barracks and clothing improved; and educational advantages are now placed within the reach of every private. The superiority of this class of troops consists in their being able to act in positions where cavalry cannot move, and it is obvious that the latter must at all times have been nearly useless in the attack and defence of towns. Even when cavalry was held in highest estimation, it was sometimes found convenient for the knights to dismount and act as infantry; and as war has become a science, the principal strength of armies is found to lie in their infantry.

Within the last few years mounted infantry have played an important part in the wars conducted by England in Egypt, and have certainly been of service. It is, however, open to question whether dismounted cavalry could not have performed the duties equally efficiently, and it would seem more reasonable that cavalry soldiers, who are constantly connected with horses, should occasionally perform duties on foot than that infantry soldiers, who are

unaccustomed to riding, should be called upon occasionally to perform the duties of cavalry.

INFEC'TION is the contamination of the atmosphere or other inert substances by the deleterious or offensive qualities of malaria, the matter of contagion, effluvia from putrid animal or vegetable substances, &c. Some of these are at once recognized by the smell or by chemical analysis, but the presence of others is known only by the diseases which they produce. The same means, however, may be applied for preventing the injurious effects of both classes.

The most important and valuable method of disinfection is ventilation; and, whatever others may be added to it, this should never be neglected. The reputation of chlorine, acids, lime, charcoal, &c., as disinfectants, depends on their property of decomposing the offensive gases which are so often mixed in the atmosphere with the matter of infection, but it is questionable whether they have any influence on the infectious particles themselves. However, as the emanations from putrid substances render the body peculiarly liable to the reception of infection, some of these means should be employed where any offensive smell is present, such as a solution of PHENOL (carbolic acid), of permanganate of potash (Condy's fluid), or free gas disengaged from chlorinated lime (bleaching powder) by the addition of water.

INFEFT'MENT, in the law of Scotland, is only another form of the English word enfeoffment, and properly speaking means the transference of the feudal right to any person succeeding another by descent, settlement, or conveyance—in other words, the investiture. Originally this might have taken place in various ways, but latterly it was restricted to the delivery of certain symbols appropriate to the special kind of property transferred, as earth and stone for lands, clap and happer for mills, &c. This was termed giving sasine, *Anglicè* livery of seisin, and the notarial instrument, which came to be the only legal evidence of the fact of infeftment, was termed "instrument of sasine." After the establishment of the registers instruments of sasine had to be recorded, priority of registration giving preference. In modern times it was seen that the only benefit of the procedure by sasine to complete the infeftment consisted in this registration. Accordingly, by 8 & 9 Vict. c. 35, the old ceremonies were rendered unnecessary provided the instrument of sasine was duly registered, and by the 31 & 32 Vict. c. 101, this was still further simplified by authorizing the conveyance itself to be registered. As the law of Scotland now stands it would be difficult to invent a more simple or more effective mode of investiture.

INFERIOR, in astronomy, is said of a conjunction of two planets when they are both on the same side of the sun and in a direct line with it. (When they are on opposite sides of the sun they are in superior conjunction.) It is said of a planet relatively to another planet when it is nearer the sun; thus with regard to the earth Venus and Mercury are inferior (all the rest are superior).

INFERIOR OOLITE is one of the subdivisions of the Lower or Bath Oolite, and is the lowest member of the Oolitic series. In the south of England it is essentially a marine formation, but thins away on proceeding north, and is subject to variations in lithological character and in thickness. It attains a maximum development of about 265 feet in the vicinity of Cheltenham, and consists almost exclusively of yellow limestone, the oolitic structure being well developed. In Northamptonshire beds of this age are sandy and often contain beds of ironstone (Northampton iron sand), above which the series contain estuarine shells (Cyrena) and terrestrial plant remains. Thin lignites, with their underclays, occur in this series. In Yorkshire these estuarine beds are thicker, with coals, shales, and sandstone; from these a considerable number of FERNS (Pecopteris, Sphenopteris, Phlebopteris, and Tæniopteris), cycads (Otozamites, Zamites, Pterophyllum, Cycadites), and conifers (Araucarites, Walchia, Taxites, &c.) have been obtained. The marine fauna is abundant: Gryphæa, Lima, Pecten, Ostrea, and many similar represent the lamellibranchs; Rhynchonella and Terebratula the brachiopods; Belemnites, Ammonites, and Nautili the cephalopods; gasteropods, sea-urchins, &c., also have their numerous representatives.

INFERNAL MACHINE is a term applied to an engine of wholesale destruction of an explosive nature, used not openly as in the art of war, but by way of conspiracy and assassination. The famous infernal machines of Gianibelli used in the siege of Antwerp (1585) were barges of gunpowder, built over with paving stones, &c., and timed to explode in the midst of the Spanish troops, which they did with alarming effects. An attempt to assassinate Napoleon when first consul by an infernal machine was made 29th December, 1800. Fieschi's gun-barrel machine was equally harmless against Louis Philippe, 28th July, 1835. Napoleon III. narrowly escaped assassination by infernal machines in the form of bombs 14th January, 1858, and the Emperor Alexander II. of Russia was killed by dynamite bombs on 13th March, 1881. From 1883 onwards for a short time frequent attempts were made in Great Britain by infernal machines constructed with preparations of nitro-glycerine, such as dynamite, &c., fired by percussion through clockwork properly timed, to create public alarm, probably the results of the extreme and lawless section of Irish conspirators.

INFINITE, INFINITY, INFINITESIMAL CALCULUS. The word infinite means literally "without bounds," and when applied in an absolute sense to magnitude means that its quantity is utterly unlimited, so that there is no conceivable and determinable magnitude but what is less than the infinite magnitude.

The notion of infinity is therefore at first purely negative, but it does not long remain so; for we are forced upon a definite notion of infinity by our consideration of time, space, and number. We cannot, if we would, annihilate our conception of space, or confine it within certain limits; nor can we suppose duration to have an end. Even if we imagine our own annihilation, we cannot rid ourselves of the idea of something else existing, with the permanent conception of unbounded space and time. If we try to conceive all sentient existence at an end, we know from reasoning that we ought to suppose also the annihilation of space and time; but the constitution of our minds will not permit it, and as long as we exist to think, even about our own non-existence, the reality of space and time will prevent our conceiving their destruction.

The other extreme in the scale of quantity is the perfect absence of all magnitude, expressed in the word "nothing," or the technical term "zero." It is necessary to treat the two together in mathematical reasoning, since all difficulties which belong to the one term belong equally to the other. We have also to consider the words "infinitely small" as well as "infinitely great."

There are three distinct methods of proceeding in regard to the employment of these terms in mathematical reasoning. First, we have those who would use the words "infinite" or "nothing" in their absolute sense, relying upon the reality of the conception which they have of the things signified by them. Secondly, there are others who would entirely banish the use of the words, because in their absolute sense they do not represent assignable magnitudes. Thirdly, others admit the use of the words, guarding them by definitions which point out the processes in the expression of the results of which they may be employed.

To the first it is answered that the absolute use of ∞ and 0 (the mathematical symbols of infinite magnitude and absence of all magnitude) in the same manner as symbols of definite quantity, is extremely liable to lead to error;

which was never avoided by the advocates of this system, except by abandoning their theory, and applying in practice the maxims alluded to under the third of the preceding heads.

To the second of the three sects above mentioned it may readily be conceded that they have a right to refuse any branch of mathematical reasoning, so far as themselves only are concerned. But the code of mathematical controversy contains no such axiom as that "mathematics is the science of assignable magnitudes only," by which to claim the submission of an opponent. The general rule is, that mathematical demonstration exists wherever there is logical deduction from universally obvious maxims with respect to magnitude. Nor does the word "universally" here mean that such maxims must have been obvious to every individual of the human race. If so there would be no such thing as mathematical demonstration, for there have been found instances in which persons have denied that the sum of all the parts makes up the whole.

We proceed to enunciate the method followed by the third of the sects mentioned. If we look at the manner in which we derive the notion of infinity, we shall not find any one who imagines that he absolutely grasps infinite space, time, or number by one single and independent conception of his mind. To space, space may be added; to this again space may be added, and so on without limit, until the space thus accumulated is greater than any definite space which was named at the outset of the process. From thence comes the notion of infinite; we cannot imagine the greatest possible space, because any space, however great, being distinctly conceived, we can as distinctly conceive a greater. Consequently the phrase "space is infinite," whatever more it may imply, certainly may be allowed to stand for an abbreviation of the preceding two sentences. And in like manner, if we see a conclusion which we can nearly attain by the use of a large magnitude, more nearly by the use of a larger, and so on without limit, that is to say, as nearly as you please if we may use a magnitude as large as we please, but which is never absolutely attained by any magnitude however great—then such conclusion may be said, for abbreviation, to be absolutely true when the magnitude is infinite. It may appear to some as if the conclusion, under the preceding circumstances, is really true when the magnitude is infinite; this may or may not be the case, but the mathematical use of the word infinite does not require the question to be raised. The convention under which that term is introduced demands that the preceding conditions shall be fulfilled, and excludes the word whenever they are not fulfilled: those who think that the fulfilment of the conditions makes that which we call a convention a necessary consequence, meet on common ground with those who would reject the absolute notion of infinity. The former are allowed their own words and their own result, together with their own method of arriving at it; the latter are not required to use the word infinite, except as an abbreviation: to the mere collocation of the letters which compose that word they can hardly object, and the conditions of its introduction are precise and intelligible.

Our explanation of the term infinite will readily show the meaning of the assertion, "Two infinitely great quantities may have a finite ratio," as follows:—When A and B are great, their ratio may be nearly, say, that of 10 to 7; when they are still greater, they may be still more nearly in that ratio, and so on; and their increase may be so regulated that the greater they become the more nearly is their ratio that of 10 to 7; or as nearly as you please, if they may be as great as we please. Similarly, two nothings may have a finite ratio. This means that A and B, both diminishing together, may diminish in such a way that when both are small their ratio may be nearly, say, that of 5 to 3; when they are still smaller, they may be still more nearly in that ratio, and so on: and their diminution may be so regulated that the smaller they become the more nearly is their ratio that of 5 to 3; or as nearly as you please, if they may be as small as we please.

But the idea of two nothings which have a finite ratio, however strictly defined in accordance with the preceding conditions, shocks even many of those who can grasp the method of using the word "infinity." The absolute nothing of subtraction has possession of the field, and it is not worth while to contest it for the use of a word. The term "infinitely small" therefore supplies the place of "nothing" whenever the latter is introduced under the conditions correlative to the conditions under which the use of infinitely great is allowed.

The *Infinitesimal Calculus* of Leibnitz regards quantities for the purposes of calculation of variables as made up of infinitely small parts, just as substances are made up of infinitely small atoms. So far as is necessary, its general nature is explained in the articles DIFFERENTIAL CALCULUS and INTEGRAL CALCULUS, which are its two great divisions.

INFLAMMA'TION (Lat. *inflammare*, to burn), a morbid process of the body, the exact nature of which is hardly yet completely understood, but which forms one of the most important of the changes in the living body observed by physicians and surgeons. When any part of the body is preternaturally hot, red, swollen, and painful, such a part is said to be inflamed or in a state of inflammation, and these characteristics of redness, heat, pain, and swelling were pointed out by some of the earliest writers on medical science whose works are extant. Some more elaborate definitions have been given by modern authors, one of the latest of whom describes inflammation as "an assemblage of phenomena held in relation with each other by the circumstance that they are all effects of the same injurious agency, and that they all form parts of one process, of which the various stages follow each other in more or less orderly succession."

When inflammation is limited in its extent and duration by the injury which caused it, it is termed *simple* inflammation; but when a condition of the body is induced in which similar inflammations are set up in other places in sympathy with the affected part, and there is general disturbance of the health, the inflammation may be termed *infective*.

Inflammation terminates most frequently by a gradual subsidence of the swelling, a diminution of the heat, pain, and redness, and an abatement of the attendant fever. The parts return to their natural size and colour, and no pus or matter is formed. This is known as termination by *resolution*, and this is the most favourable mode of termination. When the inflammation is continued until there is the formation of pus, the swelling becomes more prominent and of a shining red colour; a soft place appears in the centre, and if no artificial opening be made, the matter obtains exit through one or more orifices produced by the absorption of the walls of the cavity in which it is contained, and the inflammation is said to terminate by *suppuration*. Another termination is by *necrosis*, or the total death of the part affected. In such cases there is a high degree of inflammation, the attendant pain is exceedingly severe, the bright red colour of the part changes to purple or greenish-black, the pain then abates, and under favourable circumstances the dead part, which is termed a *slough*, separates from the living, and the cavity is filled up by the restorative power of the body.

Though it is rightly termed a morbid process, yet inflammation is frequently of a restorative character. By its means a union of divided parts of the muscular tissue is brought about, and many of the most important of the operations of surgery depend for their success upon the setting in of the process of adhesive inflammation.

The treatment of inflammation consists in the removal of all exciting causes, in giving the injured part as much rest as possible, and in attention to diet. Where an inflammation is directly accessible, local blood-letting, the application of astringents, the use of cold applications, or as the case may require, of moist heat in the form of poultices or fomentations, the covering the part to prevent access of the air, are the methods most generally adopted in dealing with it. In cases where it is not directly accessible, there are numerous medicines which act upon inflammation either by lowering the circulation generally, or by increasing particular secretions, such as mercurials, antimonials, purgatives, aconite, quinine, &c. Other means are found in the use of counter-irritants and the practice of HYDROPATHY.

INFLEX'ION, in grammar, is the term applied to those variations of the root-forms of words whereby we express modifications of their meaning or make clear their relation to other words in the sentence. As a general rule the older the language the more inflexional it is; the more modern it is, the less inflexional. Thus *reg-* being the crude-form of the Latin for king, *regs* (or *rex*) at once signifies, by a simple inflexion, the nominative case, a king; while the nominative plural *reges*, more kings than one, the genitives *regis*, of a king, *regum*, of kings, &c., are expressed by other simple variations of the inflexion. Similarly *amo* being I love, *amabo* is I shall love; *amem*, I may love; *amavero*, I shall have loved, and the like. In all these cases it will be observed that the English, a very modern language, is only able to express these modifications of noun and of verb by prepositions and by auxiliaries.

In the article AUXILIARIES these handmaids to the now stubborn verb are shown to be words having originally an independent sense of their own, which sense tends to get obscured and at last worn away by time. Thus *may*, *can*, *will*, &c., have now very little of the original meaning apart from some verb to which they serve as auxiliaries. "Can you swim?" is translated into French by "Savez-vous nager," and it is only thus that we are reminded of the ancient identity of *can* with the German *kennen*, and the English *know*. Earle ("Philology of English") records the local preservation of *should:* for instance, a man driving stakes well home said to him, "That 'n 'll stand for twenty years if he *should*," meaning if it ought, or if it was required.

But the same has also without doubt been the history of inflexions. It does not require very much study to make it fully apparent that these inflexional forms once had a definite meaning of their own, that in fact they were in prehistoric times themselves auxiliaries; though already as the languages emerge from the primeval darkness they are found to have become welded on to the root-forms which they inflect, so closely as at first apparently to defy disintegration. Then these inflexions, nearly always in the form of case or tense endings, affecting the last syllable or syllables of the word only, become rubbed away from the forms which they wear in the oldest tongues, and are worn down by the friction of ages till the "modern" tongues (which are really of course the most ancient of all) find them, in most words, absolutely worn away altogether. Then, having lost the formative inflexional element these languages replace it by the form-word, the auxiliary element. The conjecture that in future ages these auxiliaries in their turn will have become inflexions or integral parts of the verb or noun is not altogether without basis; as witness the French *aimerai*, which is nothing but *j'ai à aimer*, I have to love, or I shall love, and the attempts of our forefathers to run words together in English. Shakspeare always uses *ile* for I'll (I will), and, for rustic speech, as in "King Lear," iv. 6, *chill* for I will. Here we see that *I* was still *ich* for common folk as late as King James' time; and earlier writers tried *nelt* for *ne wilt* (thou wilt not), *navestu* for *ne havest thu* (thou hast not), *nabich* for *ne habbe ich* (I have not). In the authorized version we always find *shalbe* for shall be in the original copies, as in Isaiah xl., "Every valley shalbe exalted," &c. But the usage never gained ground, and these isolated instances therefore soon dropped out. In fact, constructive methods continue till a language reaches the fulness and complexity of the ancient Sanskrit or of the ancient Greek; but the destructive processes have also existed all along, and directly a language becomes linguistically perfect, their work begins to tell, and they quickly wear it down. At the same time new constructive processes are perpetually coming into play to restore the lost power in a new fashion. We are accustomed to think of inflexion as applicable to genders, cases, and tenses, and of the latter as relative to time. But our conception is too restricted. Many tongues use one ending for *he writes*, another for *she writes;* others use a dual number (we two, you two) as well as a plural, and might use a separate number for all the figures of the decimal system so far as the principle goes; other tongues again use one ending for *we write*, as meaning "I and my friends write," and another as meaning "I and you write," &c. But further, as to the purely time-inflexions of our verb, other languages which greatly leave the time-element to be inferred from the context yet inflect their verbs far more than we do. They would use the same sound indiscriminately for "I write," "I wrote," "I have written," but at the same time they would use quite different sounds, all modifications of the root-form "write" for "I write (continually)," "I write (quickly)," or "I write (violently, for myself, for another, to myself, to another, &c.)," or "I (order to, cease to, pretend to, &c.) write."

Although we are ignorant of all these refinements in English, and although we know only through classical sources of a "near future" and a "remote future," a "near past" and a "remote past," &c., yet as we shall see presently, English has retained the power of inflexion to a certain (very limited) extent. But there are other modern languages which have been far more conservative of their ancient powers. Italian, for instance, retains and has perhaps improved upon the old Latin faculty, akin to the qualification of the verb just named, of qualifying a noun by an inflexion instead of by an adjective. Thus instead of *una casa grande*, a large house, we should in Italian simply inflect the word *casa* into *casone*. If this house was a favourite dwelling we should use the endearing inflexion *casoncello*. To give a very few further examples, *casaccia* is a large ill-contrived house, *casamento*, a well-built roomy one, *casalone*, a ruinous barrack, *casolaraccia*, a mere shell, roofless and decayed; *casile* is a poor thatched cottage, and *casipola* a still humbler dwelling, while *casella* simply means a small house, and *casetta* is even a pretty little house, *casellina* or *casettina* answering to our cottage *ornée; casotta* is a snug house, cosy rather than large; *casino* is a summer-house, and so on. These are not derivations of *casa*, but are inflexions, equally used for other words. *Donna*, a woman, has *donnone*, a big woman, *donnaccia*, a virago, *donnetta*, a pretty little woman, and so on, in exactly the same manner. We have our English brook*let*, our mani*kin*, it is true, but this is a poor show as against the riches of Italian word-coinage.

Sufficient proof must now be given, short of detail unsuitable to the limits of this work, of the assertion made above that inflexions are the worn-down remains of words. The nominative masculine singular in Latin ends in *s*, sometimes disguised, as in *rex* = *reg-s;* this *s* is the Aryan demonstrative *sa*, Old English *se*, modern English *the*, so that *reg* meaning king, *regs* or *rex* is precisely "the king" or "that king." The genitive *s*, occasional in older languages, perpetual in English and in German (except feminines), is shown by the ancient Sanskrit forms to be

the worn-down demonstrative pronoun *syas*, *sya*, *tyat*, this or that, and so on with the rest, some more plainly, some less plainly traceable. In verbs we may take for an example *am* (I am), which is the Sanskrit *asmi*; *as* being the root, *m* the first personal pronoun, as if one were to say, be-me. In the same way *art* is the Sanskrit *asi*, the *as* having become *ar* (Grimm's law) and the *t* being the second personal pronoun (*tva* or *sva*), as if one said, be-thou. *Is* represents the Sanskrit *asti*, but *as* has become *is*, and the inflexion is altogether omitted, though in German it remains as *ist* (*er ist*, he is). Our verb (*am*, *art*, *is*) ought therefore in strict regularity to be *a-m*, *a-s*, *as-t* (or *a-t*), and here we have at once the well-known Latin terminations of the singular, as *amabam*, *amabas*, *amabat*, &c., where the *m*, *s*, *t* stand for the three pronouns I, thou, he. The verb *to be* has a further inflexion. As well as *am*, *is*, *are*, we have *be*, originally indicative. Forty-three *we be's* were struck out of the Common Prayer-book as being antiquated in 1661, and *we are* substituted for them. *Be* has come in educated, though not in local speech, to be solely subjunctive (I am—if I be, &c.) The same distinction has been more recently drawn between *was* and *were* (I was—if I were). Our *be* is the Latin *fu-*, our *have* the Latin *hab-*; and a glance is sufficient to show us that in Latin *amabo* (I shall love) is *ama-habeo* (I have to love), exactly like *aimerai* in French; and also that the Latin *amavi* (I loved) is *ama-fui* (I was to love), exactly like *aimai* (= *aimé ai*) in French. These examples are sufficient to prove the point. The loss of inflexions is not all loss; the gain of auxiliaries is not all gain. The dignity and massiveness of the ancient Roman speech has gone as a living existence, but we are able now to express ourselves with delicate *nuances* of meaning of which Latin was incapable, and which probably would have been alien to the sternness of highest Roman thought. Nothing available is so good as Latin for an epitaph, a motto, or a lightning flash of wit—a sentence is expressed in a pair of words which live in the memory for ever. It can be when it likes "double-distilled" essence of speech. Compare *Beati mundo corde* with "Blessed are the pure in heart." And again, since the connection of the words in the sentence is clear from the ample inflexions of Latin, we have almost absolute choice of position for the words themselves. We can throw the accent on whatever word we like with startling oratorical effect, either by beginning our sentence with it or reserving it till the close. *Opes irritamenta malorum* remains "wealth (is) a provoker of evils," whether we use the words direct or in other orders, as *Irritamenta malorum opes*, or *Malorum irritamenta opes*, &c. Nay, more, while with us "Peter killed the man" has a meaning the direct opposite to "The man killed Peter," in Latin it is all one whether we say *Petrus occidit hominem*, or *Hominem occidit Petrus*. In the first position Peter, in the second the man, would be the principal object of our attention, but in each Peter would be the slayer and the man the slain. No property so valuable could be given to the phrasemaker as this. Brevity is proverbially the soul of wit, and here we have brevity and accuracy combined. On the other hand, we are doomed by our dependence on auxiliaries to long-winded and cumbrous sentences, if we endeavour to copy the Elizabethans and pack all the meaning into a sentence which it will properly carry; or if we follow the modern school and aim at terseness of style, we find on examination that our sentences are in fact only parts of sentences. What is more common than to find a writer beginning a sentence with *and* or with *but*, and thus unfairly taking fresh breath in the middle of a phrase? Yet the close accuracy which our fetters of order and our troops of auxiliaries enable us to attain is a possession of great price. And if the position in this article be admitted, as must surely be readily the case, then the difference between inflexions and auxiliaries resolves itself very largely into a question of the order of words in a sentence, for the inflexions are here asserted to be the worn-down remains of auxiliary words tacked on at the end of roots (not even worn down, but fresh and untouched, in the case of the French *-ai* in *aimerai*, &c.), while auxiliaries in modern use keep their form intact, are placed generally before the words which they qualify, and if they suffer alteration it is as a loss of independent meaning rather than of independent existence. Also, by thus putting the varieties of change in front of the root-word we colour and prepare the mind for the idea sought to be conveyed; whereas by the use of inflexions we are condemned to convey the idea first by the root, and afterwards to modify it by the inflexion.

One of the great advantages of the study of Old English (misnamed Anglo-Saxon, our forefathers themselves calling it *Englisc*), is that it reveals the passage from inflected to auxiliary-aided speech. The inflexions are still there, but the prepositions, auxiliary verbs, &c., are there too. In the older poetry the inflexional element prevails, in the later poetry the auxiliary. This last stage is still well seen, among modern languages, in the modern German. It is customary to say that the language of the Bible is in structure the speech of to-day, granting certain changes of connotation in words, &c. But we can, on the other hand, trace a large growth of auxiliary forms if we look closely. Taking two examples at random, could we now say without affectation, "For if thou lendest *him*" (meaning *to him*) "count it but lost?" (Ecclesiasticus viii. 12.) Or should we not say *to him* instead of *him* in the sentence, "And sent him them to Jezreel?" (2 Kings x. 7).

Inflexions remain in English in yearly lessening numbers in many parts of speech. In *Adverbs* we have lost a very fine use of the genitive of nouns as a means of formation of adverbs, which exists now in a few words, such as *mornings* and *evenings*, *longways*, *sideways*, *northwards*, *eastwards*, *upwards*, *homewards*, &c., but which is frequent even in Chaucer. The favourite adverbial inflexion is the *-ly* added to adjectives, which represents the *-e* of the Old English accusative neuter added on to the frequent adjectival form in *-lic* (*-lic* was the adjectival, *-lice* the adverbial form, though our *-ly* does duty for both, as in comely, ungodly, &c.) Compare the Latin neuter-form adverbs *multum*, *tantum*, &c. But other inflexional forms still exist though they are rare, as the *om* of seldom, whilom, &c., which represents the Old English dative in *-um*.

In *Adjectives* we have retained only the inflexion of the comparative and superlative in *-er* (which represents an older *-es*) and *-est*, and even here we use the auxiliaries *more* and *most* very frequently for comparing short words, and practically always for comparing longer words. "A beautifuller woman" sounds pedantic to our ears, more's the pity. A few remains of a very ancient Aryan comparison in *-ma* still existed in Old English, but the all-conquering *more* and *most* have twisted them into likenesses of themselves in our modern tongue; of such are hindmost, foremost, &c., properly *hindema*, *forema*. We still construct adjectives out of the genitive of nouns in one of our few modes of word-coining left to us; we say, "a day's ride, a life's romance," or with Shakspeare (in "Measure for Measure")

> "It is excellent
> To have a giant's strength; but it is tyrannous
> To use it like a giant."

In *Pronouns* we have the distinction between the nominative and all other cases shown in the pronouns of the first and second person. I, me; we, us (four quite distinct words); thou, thee; you, ye; but *ye* has now practically disappeared, and "*thou* and *thee* and a stationary hat" are, as Thomas Carlyle said, the quaint old-world popular (but inadequate) symbols of the Society of Friends. But our pronoun of the third person is very important.

Except in local speech (as in Hampshire, where "everything is *he* save a tom-cat") and in the affection of sailors and engine-drivers for their ships and engines, which leads them to style them *she*, sweetheart-fashion, in the language of poets and in a few such cases, gender has disappeared as completely from English as it has from the modern Persian. Turks and Finns also distinguish not between *he*, *she*, and *it*, but they probably, unlike the Persians, never enjoyed that power. English presents an aspect midway between these; it preserves the expression of gender in one sole instance, the familiar *he*, *she*, *it*; *him*, *her*, *it*, though the plural of these, *they*, *them*, has, like the other pronouns, but one form for all genders in each of the two case-forms to which English pronouns are limited. *Him*, which serves us for both dative and accusative, is truly dative in form; the true Old English accusative *hin* (or fully, *hine*) is only found in dialects such as the Devonshire, "I drow'd en down" (I threw him down). *Whom* and *whose* are the only other inflected pronouns in English.

In *Nouns* all we have left by way of inflexion is the *'s* of the genitive and the *s* of the plural number, except one or two plurals in *en*, as oxen, brethren, and a few made by vowel changes, such as foot, feet; man, men, &c. There were three numbers in personal pronouns in Old English, which retained the dual or plural-of-two, common to the whole of Sanskrit and Greek words; but in other Old English nouns there were only the two numbers, singular and plural. The plural ended in *-as*, *-an*, *-u*, *-a*, *-o*; after the Norman Conquest these were reduced to *-es* and *-en*, and so fell to our *s* or *es*. There were six cases in Old English (nominative, vocative, accusative, genitive, dative, and instrumental), but what are these against the Sanskrit seven for each number, or the Scythian fifteen or twenty? In some of the Old English declensions the genitive singular masculine and neuter (but not feminine) ended in *es*, whence our present genitive *'s*. It was not till the thirteenth century that *'s* became the genitive of feminine nouns, and even to this day while we speak of *Lord's day* we yet speak of *Lady day*. The apostrophe served to distinguish the genitive from the plural *s*; but the Stuart grammatists took it, rather absurdly, for a contraction of *his*; and we find an attempt made, as in the Bible, to perpetuate this, and even to correct the feminine form in accordance with it, such as "Sarai her name is changed," in the heading of Gen. xvii.

But the *Verb* is our great stronghold of inflexions; and this is most natural, for as the chief movable element of speech it is probably the first to be inflected, and the habit becomes so firmly ingrained that verbal forms remain when all others have long perished. But after all it is little enough we have to boast of even in our verbs in the way of inflexions. The English verb has suffered more than the verb of any other language by the ravages of time. We have two forms of the past tense, one (the weak form) adding *-ed* or *-d* to the root, the other (the strong form) altering the vowel of the root. The strong form is believed to be a relic of reduplication; *did*, past of *do*, is certainly like the Latin *dedi*, the Greek *tetupha*, &c.; but we have hardly any other examples so clear. In Latin *feci* is made by those steps *facio*, *fafaci* or *fefici*, *feci*; and doubtless the same process occurred in English, but our words are so worn that the duplicated letters had disappeared before the writing of our earliest record. Take an example of a strong verb and a weak one, and enumerate all the inflexions the word undergoes, and how many are they? Take *write* and *fold*, for instance. The first gives us *write*, *writes*, *wrote*, *written*, *writing*; the second, *fold*, *folds*, *folded*, *folding*, and that is all. It is true that in poetry and in local speech we can yet furnish forth one or two more forms—*writest*, *writeth*, *wrotest*, and so also *foldest*, *foldeth*, *foldedst*. With these four (or in the case of strong verbs five) forms we have to express every inflexion of the verb, and as it is impossible to do this we are therefore quite dependent upon auxiliaries to eke out the scanty materials.

INFLEXION, in optics and acoustics, corresponds to diffraction; that is, the property of light or sound to turn from its direct course when it passes near the edge of an opaque body. See DIFFRACTION.

INFLEXION, POINT OF, in geometry, is the point of contact of a stationary tangent—namely, the point at which the curve passes from one to the other side of its tangent, and towards which it always turns its concavity. It is sometimes called a point of contrary flexure.

INFLORES'CENCE. The buds in certain parts of a flowering plant at stated seasons bring forth leaves which are changed from the foliage type into structures fitted for the production of seed. These flower-buds unfold into a system of branches, each arising from the axil of a small leaf, the bract. The single flower, or system of flowers, arising from one point is called the inflorescence. The simplest form is known as a scape (Plate INFLORESCENCE, fig. 1), where the flower-stalk rises from the ground and is destitute of leaves. Another simple form is when single flowers are axillary, as in fig. 2.

The different forms of inflorescence may be arranged under two heads, centripetal or indefinite, in which the flowers open from base to apex or from circumference to centre, and centrifugal or definite, in which the terminal bud forms a flower or does not develop, so that the flowers open from the apex to the base or from the centre to the circumference. Of centripetal inflorescences, the spike (fig. 3) has the flowers sessile on the main stalk. A spikelet is a small spike in the inflorescence of grasses and sedges (fig. 7). A catkin is a hanging spike of usually unisexual flowers (fig. 4), as in birch, oak, willow. The spadix (fig. 5) is thick and fleshy, as in the Arum, and is sometimes branched, as in palms. The raceme (fig. 6) differs from the spike in having the flowers all stalked. The panicle (fig. 7) is a compound raceme. The corymb has the pedicels arising from different points, as in the panicle, but the lower stalks are longer than those above, so that the flowers are almost level. The umbel (fig. 8) has pedicels springing from the same point. The head or capitulum (fig. 9) has a number of flowers sessile on an expanded surface, as in the dandelion, teazle. The capitula of the orders Compositæ and Dipsaceæ are surrounded by overlapping bracts, forming the involucre. Clover (fig. 10) has a capitulum without an involucre.

Cyme is a general name for centrifugal inflorescences. Adjective terms derived from indefinite forms are often applied; thus there are spiked, racemose, corymbose (fig. 11), panicled, and umbellate cymes. A thyrse (fig. 12) is a dense panicled cyme, as in lilac. A verticillaster (fig. 13) is compound of two dense axillary cymes, as in dead-nettle and other labiates.

INFLUEN'ZA (*i.e.* owing to the influence of the stars) is the name given by the Italians to an epidemic catarrh which has spread more extensively than any other epidemic; and this universality of its attacks, together with the greater severity of its symptoms, principally distinguishes it from common catarrh. It attacks all ages and conditions of life, but it seldom proves fatal except to the aged or to those previously suffering from or having a tendency to pulmonary disease. Notwithstanding the great frequency of this epidemic it is remarkable how little variety there has been in its symptoms, and the records of cases which occurred in 1510 nearly resemble those which have been observed during its latest visitations. Another epidemic occurred in 1557, and spread not only over Europe, but also over the whole of the northern hemisphere. Beginning in Asia, it extended westward over the European continent, and reached America, where it terminated. Numerous outbreaks have since occurred at widely different intervals. Its progress is not checked by oceans or rivers,

and it attacks the sailor on the sea as well as the dweller on the land. It has frequently visited London with great severity. In September, 1729, it carried off 1000 persons weekly, and in 1847 the mortality arising from it was nearly as terrible. Its causes are still obscure, though there can be no doubt that its increase and diminution are closely connected with atmospheric changes, but their nature is quite unknown. The disease has prevailed in the same locality in all seasons and in almost every variety of weather, and it is met with in the dry, warm air of Upper Egypt, in the moist air of sea-coasts as well as on the sea itself in ships out in mid-ocean. It has been suggested that it results from the existence in the air of some noxious and irritant vapour, though in a very minute quantity, but there is no foundation for the theory which connects it with volcanic action. Another hypothesis is that influenza is caused by an excessive accumulation of electricity in the animal economy, or by a peculiar electrical condition of the atmosphere; while the latest theory on the subject finds the cause in the presence in the atmosphere of an excessive quantity of ozone. The disease has always travelled from east to west, and true influenza never occurs as a sporadic disease.

There does not seem to be any method by which an attack of influenza can be prevented during the prevalence of an epidemic, for although unfavourable hygienic conditions, such as defective drainage, impure air, overcrowding, and insufficient clothing and food, add to the severity and fatality of the disease, persons who are most favourably circumstanced are readily attacked. The symptoms by which the onset of this disease are generally marked are slight chills and shivering, succeeded by flushes of heat and dryness of the skin. These are followed by headache, a copious discharge from the nostrils, hoarseness, sore throat, and cough. There is great debility from the outset, and usually much depression of spirits; the digestive organs are disturbed, and pains are felt in the back, limbs, and other parts of the body. The treatment of this disease consists in assisting the action of the skin by means of a footbath and some simple diaphoretic, the administration of a mild aperient to relieve the bowels, and the application of sinapisms to the chest. There is generally a complete loss of appetite, but such liquid food as can be taken should be freely given, and after the severe symptoms have subsided the consequent debility requires the use of tonic medicines and a liberal nourishing diet. Influenza, when it is uncomplicated with any other chest disease, is not a very fatal complaint, and its ordinary duration is only a few days; but the attendant weakness often lasts for a long time, and there is also a tendency to relapse. The great mortality that has attended the epidemics has arisen from the immense numbers attacked, and from the fact that influenza increases very greatly the danger caused by ordinary affections of the chest.

IN FORMA PAUPERIS. See FORMA PAUPERIS.

INFORMA'TION, a complaint exhibited before the Queen's Bench division, in law, against a person for some misdemeanour. It differs from an INDICTMENT principally in this, that an indictment is an accusation found by the oath of a grand jury, whereas an information is simply the allegation of the person who exhibits it. Informations are of two sorts; those which are partly at the suit of the king and partly at that of a subject; and, secondly, such as are in the name of the king only. Informations which are partly at the suit of the king and partly at that of a subject, are generally exhibited upon penal statutes, which impose a penalty on the offender, if he is convicted, one part of which is for the king and the other part for the informer.

Informations exhibited in the name of the king alone are either filed *ex-officio* by the king's attorney-general at his own discretion, when they are called *ex-officio* informations, or they are exhibited in the name of the king by some private person or informer. *Ex-officio* informations are filed in the case of great misdemeanours which disturb the king's government or interfere with the discharge of his kingly office.

Formerly, when it was necessary for the Court of Chancery to interfere with the regulation or management of any charity, the attorney-general as informant, on the relation of some person (who was called the relator), filed an information in the Court of Chancery for the purpose of bringing the case before the court. For this procedure an action in the High Court is substituted by the Judicature Act.

INFOR'MER, in English law, is a person who lays an information or prosecutes any person for some offence against the law or a penal statute. Such a person is generally called a common informer, because he is supposed to make a business of laying informations for the purpose of obtaining his share of the penalty. Persons are induced to take the trouble of discovering offences, for which a pecuniary penalty is inflicted on the offender, by the promise of the reward; and if the penalty is imposed for the public interest, he who makes the offender known does the public a service. Of late years, since the establishment of the police force, the common informer's vocation has almost fallen into desuetude.

In Scotland an informer has the same meaning, but it also denotes the party who sets the lord advocate in motion in criminal prosecutions, and he is liable to action at law in case of a malicious prosecution.

INFU'SIONS are solutions of some of the principles of vegetables, generally in water, but occasionally in other vehicles. When water is employed, it may either be hot or cold. It is customary to use warm water, but in many instances cold is preferable. Sometimes alcohol is added, after straining, to assist in keeping the infusion or to increase its powers. Hard water should, if possible, be avoided in the preparation of infusions.

INFUSOR'IA is a class of the PROTOZOA, the lowest subkingdom of the animal kingdom. The term Infusoria is now much restricted in meaning. When first used it was applied to all the minute forms of living things or animalcules which were discovered by the aid of the microscope to exist in inconceivable abundance in ponds, rivers, and seas, and indeed in every drop of water containing animal or vegetable substances. The first explorer in the new world which the microscope had created was Van Leeuwenhoek, who published the result of his studies in the *Philosophical Transactions of the Royal Society* in 1667. He was followed by Baker (1742) and Müller (1773). Ehrenberg (1836) inaugurated a new era in the knowledge of the lowest forms of life. He included under the name Infusoria minute animals, such as the wheel-animalcules (ROTIFERA) of high organization, as well as the simple unicellular animals, and also numerous unicellular plants, such as BACTERIA. The labours of subsequent observers, such as Dujardin, Von Siebold, Stein, Claparède, Lachmann, Haeckel, Engelmann, Bütschli, and Saville Kent, have led to the breaking up of Ehrenberg's heterogeneous class Infusoria; by many the term is altogether given up as more or less meaningless at the present day. It is, however, convenient to retain the name Infusoria for Protozoa, whose body consists of a single nucleated cell having its protoplasm denser on its surface, and possessing normally a distinct mouth for the ingestion of solid food, and also special organs of locomotion and prehension.

To get an idea of the characteristics of the Infusoria it will be well to study somewhat closely one of the more typical forms. The Slipper Animalcule (*Paramecium aurelia*), common in stagnant ponds, is a convenient example. The slipper animalcule is one of the largest

of the group, measuring from $\frac{1}{120}$ to $\frac{1}{100}$ of an inch in length. The body, unlike such Protozoa as AMŒBA, maintains a definite shape; it has some resemblance to a slipper in shape, being flat, longer than it is broad, and blunt at one end and sharp at the other. The body consists of a single cell of protoplasm, but is more complex than that of the amœba, as the body-substance is divisible into two distinct layers. The protoplasm in the centre of the body is soft, semifluid, and granular; this medullary substance passes near the surface of the body into a dense firm substance, only slightly granular, forming the cortical layer. The cortical layer, which is thicker at the anterior end, is bounded by a delicate skin or cuticle. The whole body is thickly clothed with vibratile processes of protoplasm, called cilia, the lashing of which drives the animal through the water with great rapidity. About the middle of the body there is a hole in the cortical layer, leading by a narrow tube (pharynx) into the medullary substance; this is the mouth. The cilia, in addition to their locomotive function, beat into the mouth currents of water in which are minute particles of vegetable substance, &c. The water and its contents are swept down the pharynx till they meet the soft naked protoplasm forming the medullary substance; into this the particles of food sink, each carrying in, surrounding it, a drop of water, forming a food-vacuole. Within these food-vacuoles the process of digestion goes on. There is a certain circulation of these food-vacuoles round the body within the medullary substance, the nutritive matter and the water being gradually absorbed by the surrounding protoplasm, till, when the region of the pharynx is again reached, only indigestible matter remains, which falls into the pharynx, and from thence is swept into the water. These food-vacuoles are the "stomachs" of Ehrenberg, the observation of which led him to form a group (Polygastrica) of his order Infusoria. The nucleus is a large oval body; close to it is a small body, the paranucleus. In the cortical layer near either end of the body are two clear spots, which gradually expand and then suddenly disappear, reappearing again in the same place and again expanding; these are the contractile vacuoles. They have commonly a star-like appearance, but become spherical before bursting. The contractile vacuole, having attained a certain size, reaches the surface of the body and bursts, discharging the water it contained. It performs the office of a kidney, washing out of the protoplasm the waste nitrogenous matters. The cortical layer also contains a number of small rod like bodies (trichocysts), which, like the thread-cells of Hydra, shoot out a thread on irritation.

The normal method of reproduction in Paramecium (as in most Infusoria) is division. A peculiar method, known as rejuvenescence, occurs in this genus, and very generally in the order to which it belongs. Two slipper animalcules come together and fuse. The nucleus and paranucleus of each individual break up, and their protoplasm probably becomes thoroughly mixed. After a time the two individuals separate, each assuming its old shape. From the observations which have been made it is probable that the new nuclei are formed afresh by the protoplasm, the fragments of the old nuclei forming the new paranuclei, and the fragments of the old paranuclei being cast out during the process of conjugation. Occasionally when two individuals have fused, a spherical shell or cyst is formed round them; after a time the cyst bursts, giving exit to a number of minute spores, each of which grow into the parent form.

The class Infusoria may be divided into five orders, based upon the character of the organs of locomotion—Tentaculifera, Ciliata, Cilio-flagellata, Flagellata, and Proboscidifera.

The Ciliata form the most numerous and important order. The body is more or less provided with vibratile cilia. The order Ciliata is divided into five suborders, dependent upon the position of the cilia. In the first suborder, Holotricha, the cilia are uniformly distributed over the body, and trichocysts are usually present. To this suborder belongs Paramecium, whose life-history is detailed above. *Trachelius ovum* (Plate, fig. 1), a large form, has its medullary substance curiously vacuolated, like the protoplasm of a young vegetable cell. In some genera, as Enchelys (fig. 2), Leucophrys (fig. 3), and Coleps (fig. 5), the cilia surrounding the mouth are longer than those on the rest of the body. Some forms are flask-shaped, with a long neck, at the end of which is the mouth; an example is shown in fig. 4. *Nassula elegans* (fig. 6) is closely allied to Paramecium. Ophryoglena (fig. 7), common in stagnant water, is an example of a section of this suborder having a vibratile flap or membrane within the mouth. Cyclidium (fig. 8) is an allied form. Some of this suborder are parasitic, and have lost the mouth and contractile vacuoles. *Opalina ranarum* is found in the intestinal canal of frogs and toads. It is ovate in shape. The nucleus is broken up into very numerous fragments dispersed through the body. In the spring Opalina divides so fast that growth cannot keep up with reproduction, and each Opalina thus formed by division consists of a single nucleus surrounded by a small quantity of protoplasm. Each particle encysts; in this state they are passed out when the frog lays its eggs, and are swallowed by the tadpoles when hatched. Some curious forms (Trichinomorpha), parasitic in the intestines of the termites or white ants, are also placed in this suborder.

The suborder Heterotricha has, in addition to the short cilia on the general surface, large cilia developed round the mouth in a spiral or circular band. The Trumpet Animalcules (Stentor, fig. 9) belong to this group. They are usually fixed to some solid substance, but can detach themselves and swim freely. The body is trumpet-shaped, the cilia forming a ring round the broad end and turning in spirally to the mouth. The nucleus is long and canal-like. Some of the species contain chlorophyll granules. In Tintinnus (fig. 10) the cuticle forms a shield or lorica. Some parasites are also found in this group. Balantidium, found in the human intestine, possesses a mouth; Nyctotherus, found in the intestine of the black beetle, has not only a mouth, but an anus, a special exit for the undigested matter.

The suborder Hypotricha (figs. 11–15) has the cilia confined to the ventral surface. The cilia are peculiarly modified into strong muscular processes. The members of this group are free swimmers, but also make use of their cilia in walking on stalks of plants. *Chlamydodon mnemosyne* (fig. 12) lives in salt water; it has a kidney-shaped body with many contractile vacuoles. *Euplotes charon* (fig. 15) has a hard cuticle, and the cilia collected more or less at either end of the ventral surface.

The suborder Peritricha contains many beautiful forms, some fixed and forming branched tree-like colonies. The cilia are confined to one or two bands, one surrounding the mouth sometimes being disposed spirally. This suborder contains the well-known genus Vorticella (bell-animalcule, fig. 16), which is fixed during the greater part of its life by means of a long stalk which is a prolongation of the cuticle. Epistylis and Carchesium are very like Vorticella in appearance; they form most beautiful tree-like colonies, springing from a common stem. Vaginicola (fig. 17) has the cuticle of the posterior end of the body converted into a silicious sheath (lorica), into which the animal can be retracted.

The suborder Calycata has been established for a single genus, Torquatella, a marine form, in which the cilia are replaced by a vibratile collar.

The order Tentaculifera contains forms which are permanently fixed when adult, and have no cilia. The body is provided with a number of retractile tentacle-like tubes,

each having at the extremity a disc-shaped mouth, which acts as a sucker. If an animalcule, swimming by, chances to touch one of these tubes it is seized, the tube contracts, and the nutrient matter of the victim is sucked out and passes down into the body. The typical genus is Acineta, in which the body is triangular and contained in a cup-like sheath. The nucleus is very large and often branched. Reproduction is effected in this order by division or gemmation. The young are free-swimming and resemble the Ciliata.

The Cilio-flagellata are mostly found in sea-water, producing to a large extent phosphorescence. The body is more or less covered with cilia, and in addition is provided with a flagellum, which is a long lash-like process, vibratile at the tip, which by its lashing drags the body along. Some of the Cilio-flagellata have the cuticle converted into a horny cuirass, or prolonged into horn-like processes, as in Ceratium (fig. 18). The largest forms belong to the genus Ceratium. All the members of this order are free-swimming. Reproduction is by division as a rule. Heteromastix has two flagella, one of which is actively vibratile.

The order Flagellata forms the lowest group of the Infusoria. It is characterized by the possession of one or more flagella. It is extremely difficult to decide the limits of this order. Many of the lower Protozoa, such as the order Monera, as well as many of the lowest plants, at some stage of their life-history assume a monadiform condition quite similar to the Monads of the order Flagellata. The lowest Flagellates have no true mouth, food particles entering at any portion of the body. After separating as plants those flagellate forms which do not take solid food, there still remain some forms, such as Volvox and Chlamydococcus, the position of which is a matter of dispute. The Monads include the genera Monas, Cercomonas, Rhipidodendron, forming a large branching fan-shaped colony, Hexamitra with six flagella, Cladonema, &c. The second suborder of the Flagellata is Choano-flagellata (fig. 21), containing the collared monads, in which the cortical layer is drawn up into a hyaline cup, from which the flagellum projects. The collared monads sometimes form colonies of considerable complexity. Some form beautiful tree-like colonies (Codosiga). In some the cuticle forms a posterior cup in the shape of a lorica (Salpingœca). The last suborder of the Flagellata is Eustomata, in which there is a definite mouth for the inception of food. One of the largest and best-known of these is *Euglena viridis* (fig. 20), occurring in green masses in ponds in spring. The green colour is due to the presence of chlorophyll. The body is retractile, and there is a single flagellum, at the base of which is situated the mouth. Astasia (fig. 19) also belongs to this suborder. Reproduction is by fission and by spore-formation.

The order Proboscidifera has been established for the genus Noctiluca, containing two species. The common species, *Noctiluca miliaris*, is found in all seas, and is the principal cause of the phosphorescence of the sea. It is a large form, varying from one-twentieth to one-eightieth of an inch in diameter. The body is peach-shaped with a meridional groove, at one end of which is the mouth. Near the mouth is a vibratile muscular process as long as the body. There is also a short flagellum. The cuticle is silicious. The internal protoplasm is largely vacuolated, as in *Trachelius ovum:* the nucleus is oval in shape. Scattered in the cortical layer are numerous oil globules, the oxidation of which causes the luminosity. The Noctiluca feeds on minute Algæ, &c. Reproduction is by spore-formation, and occasionally by conjugation. A second species of this genus is found in the Mediterranean, having a disc-like shape.

("A Manual of the Infusoria," by W. Saville Kent, London, 1882.)

IN'GA (the South American name for one of the species), a genus of plants of the order LEGUMINOSÆ, which contains about 140 species. These are found in the tropical parts of America. Many are important in the countries where they are indigenous, either for astringent properties, like many mimosas and acacias, or for the edible nature of the fecula or pulp which surrounds their seeds. The pods of *Inga vera*, a native of the West Indies, are sickle-shaped, about 6 inches in length. The seeds are embedded in a sweet pulp, which possesses purgative properties. The natives of Panama cultivate *Inga spectabilis* for the sweet pulp of the pods, which affords excellent food.

The genus is characterized by the parts of the flowers being in fives; the flowers are large, and sometimes are disposed in heads or umbels; the corolla is tubular, the petals united to about the middle; the stamens numerous, and protruding some way beyond the corolla; the anthers small, the pollen in each cell being aggregated into distinct masses; the pod is linear, with the seeds embedded in sweet pulp.

IN'GOT, a bar of one of the precious metals. Originally it was the mould or matrix into which the molten metal was poured for the purpose of casting it into bars (Ger. *eingiessen*, Dutch *eingieten*, to pour in; French *l'ingot* has now become *lingot* by corruption). Copper, tin, lead, &c., cast thus are called *bars;* gold and silver bars alone are *ingots*. Chaucer shows the original meaning in the "Canterbury Tales" (crosslet being a crucible).

> "He put this once of copper in the crosslet,
> And on the fire as withe he hath it set,
> And afterward in the ingot he it cast."
> —*Yeoman's Tale.*

INGRES, JEAN AUGUSTE DOMINIQUE (1780-1867), a modern French painter of some repute, was born at Montauban, studied under the severe David, won the chief prizes at the Academy in 1800 and 1801, and in 1806 went to Rome, where he remained till 1820, then proceeding to Florence till 1824. Returning to Paris he was elected, in 1829, professor of painting in the Fine Arts School; but failing to gain the goodwill of the Parisian public, although his studio was crowded with scholars and he was a recognized leader of art, he accepted in 1834 the Directorate of the branch of the French Academy at Rome (the famous Villa Medici). In 1845, having in the meantime returned to France, he was named commander, and in 1855 grand officer of the Legion of Honour. The latter honour followed upon his great triumph at the International Exhibition at Paris, where a whole room was set apart for his works. He is correct and classical in design, and sober in colouring almost to frigidity; all his life he was a virulent opponent of sensationalism, and of what is called the romantic in art. Nevertheless his "Source," which had been partly finished many years previously, and which now first appeared as a complete masterpiece, was welcomed as a revelation in the great International Exhibition of London in 1862. Again political honours followed an artistic triumph. The Emperor Napoleon III., gratified at the acclamation of Ingres' great powers, created him Senator of France. Without being a painter of the highest genius, Ingres stands honourably high among the moderns; and his great mechanical skill, his consummate knowledge, though shown chiefly in patient quiet work, is not without great effectiveness of its own kind. He died in 1867.

INHALA'TION, in medicine, is a method of introducing remedies to the respiratory tract, which, though known from the earliest periods, has only of late years received full recognition from the medical profession. It is employed chiefly in diseases of the pharynx, larynx, and the air passages. In connection with the latter it was proved by a series of experiments carried out at the Académie de Médecine of Paris, that medical sprays when inhaled

penetrate to the finest ramifications of the bronchial tubes, and are even absorbed into the circulation. There are several kinds of spray apparatus made by medical instrument manufacturers, some of which are worked by means of a hollow elastic ball, which being pressed in the hand drives a jet of air through a couple of small tubes placed at a certain angle to each other, while other forms are worked by means of steam. The object in either case is to present the liquid used in a spray fine enough to be readily inhaled into the lungs. There are also numerous inhalers designed to present the remedial agents in the form of vapour or mingled with steam, but for these a good substitute may be found in a common jug having a wide mouth. This should be partly filled with hot water, and the material to be inhaled having been put into it, a towel should be put round between the mouth and nose of the patient and the opening of the jug to prevent the escape of the vapour. The inhalation of the steam from hot water alone has a very soothing effect in cases of dry and inflamed throat, in the earlier stages of croup and laryngitis, and in bronchitis. More powerful sedatives are found in the vapours of conium, chloroform, and hydrocyanic acid, or in the sprays of bromide of ammonium, or the acetate of morphia suitably diluted with water. Chronic bronchitis is often greatly relieved by the inhalation of ipecacuanha spray made by diluting ipecacuanha wine with twice its bulk of water. Other inhalations are found in the compound tincture of benzoin (friars' balsam), of which a teaspoonful may be put into a pint of hot water and the vapour inhaled, and iodine, of which the quantity is ten drops of the tincture to the same quantity of water. Spasmodic asthma may be relieved by inhalations of the fumes of nitre paper, and the smoke of stramonium, tobacco, and opium is sometimes employed for the same purpose.

INHER'ITANCE, in biology. The general principle that in animals and plants any character tends to be inherited, that in other words "like begets like," is well known. The laws governing this principle are somewhat complex, but admit of being stated with some definiteness. The subject of inheritance or heredity has been specially investigated by Darwin in his "Variation of Animals and Plants under Domestication," and his main conclusions may be briefly stated. The attention given to breeding useful domesticated animals shows how strong is the force of inheritance; but it shows also that the inheritance of any character is not certain, for if it were the breeder's art would be reduced to a certainty. The force of inheritance is not too strong to allow the incessant appearance of new characters, which are themselves inherited either temporarily or permanently. The truth of this scarcely needs illustration. In man malformations, trifling peculiarities, such as the colour of a lock of hair, tricks of manner, intellectual attributes, longevity, and diseases are so constantly and strictly inherited as to put out of question mere coincidence. With other animals and with plants the evidence is strong. Youatt remarks that there is scarcely a malady to which the horse is subject which is not hereditary. In the case of man and the higher animals "there is a considerable body of evidence showing that mutilations, and the effects of accidents, especially or perhaps exclusively when followed by disease, are occasionally inherited." It is asserted on good authority that disease is hereditary with plants.

The principle of inheritance, strong as it is, appears sometimes to act capriciously, transmitting the same character, such as the weeping habit of trees or the colour of flowers, sometimes with great strength, sometimes feebly or not at all, even in different individuals of the same species. In many cases the tendency to inheritance may be overborne by unfavourable circumstances. Sheep in tropical countries lose their wool in a few generations; nor can our cabbages form heads in hot countries.

Apparent failures of inheritance are often due to the great principle of ATAVISM or reversion—an animal or plant reverting to some character possessed by an ancestor. It is probable, however, that the sudden reversion is more apparent than real, the character in question lying latent in the immediate parents. In the case of pure breeds the reversion may be to some character possessed by the wild progenitor, but lost through variation thousands of generations before. Various pure breeds of pigeons occasionally revert to the slaty-blue colour and characteristic markings of the wild rock-pigeon (*Columba livia*). The occasional appearance of black sheep in the most improved breeds is a case of atavism. When a domestic animal or cultivated plant becomes feral, that is, returns to its natural conditions of life, a tendency to reversion exists, though it is by no means strong. When two distinct races are crossed, the tendency in the offspring to revert to one or both of the parent forms is very strong and endures for several generations. Darwin also proves that the act of crossing gives a strong tendency to the re-appearance of long-lost characters not exhibited by either of the parent forms. Thus by crossing distinct breeds of pigeons and recrossing their mongrels, he constantly produced birds exhibiting more or less the characteristic colour and markings of the wild rock-pigeon. The hybrids produced by the crossing of a domestic breed with a distinct species, either domesticated or only tamed, are singularly wild.

When two individuals of the same family or of distinct races or species are crossed, one is often found to have great power in transmitting its likeness. This prepotency of transmission may be confined to one sex, or be common to both sexes of the prepotent form. The jackal is prepotent over the dog. The ass is prepotent over the horse, but the prepotency is stronger in the male than in the female ass. A breed may transmit its characters very truly when kept pure, but when crossed show a singularly weak power of transmission. Thus among pigeons the fantail usually, and the trumpeter invariably, yield to the prepotency of every other breed.

Another law of inheritance is sexual limitation. When a new character appears in either parent, it tends to be transmitted more or less exclusively to the offspring of the same sex. This law holds good in man with regard to colour-blindness and various diseases. In this way we can explain the curious fact that tortoise-shell cats are generally females, the corresponding colour in the males being rusty red.

A principle upon which Darwin lays great stress, is that of "inheritance at corresponding periods of life." A new character tends to appear in the offspring at whatever period of life it first appeared in the progenitor. Well-known illustrations of this rule are insanity and various diseases in man. This principle throws a flood of light on the difference between the embryo and the adult animal, which often obtains to so remarkable a degree. It also explains why "the embryos of widely different animals which are descended from a common progenitor, remain in many important respects like each other and their common progenitor" (Darwin). The process of development is sometimes accelerated, and the character is inherited at an earlier period. The following complemental rules given by Darwin often hold good—"That variations which first appear in either sex at a late period of life tend to be developed in the same sex alone; while variations which first appear early in life in either sex tend to be developed in both sexes." Darwin seeks to explain these complex laws of inheritance by his theory of pangenesis, advanced in his "Variations of Animals and Plants under Domestication."

IN'IA is a genus of mammals belonging to the order Cetacea and family Platanistidæ. Only one species is known, the Amazon Dolphin (*Inia geoffrensis*), inhabiting the river Amazon and its tributaries. This animal is 7 or

8 feet in length. The colour is variable, commonly pale blue above, passing into a roseate hue beneath. The head is provided with a long cylindrical beak, which is thinly covered with thick crisp hairs. The dorsal fin is very small. The flippers are broad and of moderate size. The lips are deeply cleft to beneath the eye. The teeth vary in number from twenty-six to thirty-four on each side of both jaws. The inia feeds on fish. According to Bates it is held in great veneration by the natives, who can hardly be induced to harpoon it; they think that blindness results from the use of the oil, which is excellent for lamps.

INJEC'TIONS, in medicine, are such fluids as are introduced into any part of the body by means of a syringe or any similar apparatus. When medicines are introduced under the skin they are termed HYPODERMIC INJECTIONS, and when fluids are thrown into the rectum they are commonly called *enemata* or CLYSTERS. Injections are frequently used in the treatment of diseases of the urethra, the bladder, the lower bowel, the vagina and uterus. In *intravenous injections* the fluid is introduced into the veins, and sometimes in cases of severe hæmorrhage blood is transfused in this way. See TRANSFUSION OF BLOOD.

INJUNC'TION. An injunction is a writ which issues by the order and under seal of a court to prevent or stop the procedure of an illegal act. It is used for the following purposes among many others: to restrain parties from proceeding in other courts, from negotiating notes or bills of exchange, to prevent the sailing of a ship, the alteration of a specific chattel, to prevent waste by felling timber or pulling down buildings, the infringement of patents or copyright, to repress nuisances, and to put an end to vexatious litigation. The writ of injunction is useful in stopping or preventing wrongs for which the ordinary legal remedy is too slow, and injunctions may now be granted by all divisions of the High Court of Justice and by the Court of Appeal. By the Judicature Act of 1873, sec. 25, sub-sec. 8, it is provided that "a mandamus or an injunction may be granted, or a receiver appointed by an interlocutory order of the court in all cases in which it shall appear to the court to be just or convenient that such order should be made." See INTERDICT.

INK (Dutch, *inkt;* French, *encre*, from the Greek *egkauston*, pronounced *engkaushton*) consists of several varieties, the most important being writing and printing ink.

Writing Ink.—The writing ink of the ancients was essentially different from that which is now employed. Its basis was finely divided charcoal, a lampblack mixed with some mucilaginous or adhesive fluid; it was much less destructible than modern writing ink, and more resembled printers' ink. Writing ink is now a chemical compound, and not a mere mechanical mixture. The best black ink is a tannogallate of iron, and is made by adding an infusion of nut-galls to a solution of ferrous sulphate (copperas). The galls contain gallotannic and gallic acids; these on coming in contact with ferrous salts produce white precipitates, which turn black on exposure to air; with ferric salts deep black precipitates are at once produced. A small quantity of gum is added to retain the precipitate in solution. A good ink must have a sufficiently strong colour to be distinctly legible when first written, and at the same time should not possess its full colour; it should to a very slight extent sink into the paper, where by subsequent oxidation its greatest depth of colour is developed. When ink consists chiefly of tannate of ferric oxide it is a dense black liquid, but rests merely on the surface of the paper, and it is therefore less permanent than when part of the black colour is in the paper itself.

Ink, as it is usually prepared, is very apt to undergo certain changes which render it unfit for use; of these the most important are:—(1) its tendency to become mouldy; (2) the liability of the black colouring matter to separate from the fluid, the ink then becoming what is termed ropy; (3) its loss of colour, the black changing to brown, and at length almost entirely disappearing. Mouldiness is prevented by adding a few drops of carbolic acid, creosote, some essential oil, or finely-bruised cloves, first mixed with strong acetic acid. The separation of the colouring matter is retarded by adding a small quantity of an acid, the ferrous salt being thus hindered from passing into the ferric salt. The change of colour can only be prevented by taking care that the copperas is not in excess of the gallotannic acid, by keeping the ink excluded from the air, and by avoiding the use of any mineral acid. If the ferrous sulphate is in excess, although the ink may be at first very black, it will subsequently become brown, and then yellow. The discolouration of ink in old documents is frequently due to the chlorine compound used in bleaching the paper not having been entirely removed. With the present modes of making paper this accident is not likely to occur.

The proportions used by different ink makers vary greatly; Watts gives the following recipes:—

	Parts by Weight.					
Galls, ...	225	187	133	125	66	62
Ferrous sulphate, .	75	73	55	24	22	31
Gum-arabic, . .	25	73	55	24	19	31
Water, ...	1000	1000	1000	1000	1000	1000

Stephens' ink, a blue fluid which shortly after use becomes an intense black, is thus made:—Exhaust forty parts by weight of nut-galls with 112 parts of water; to the filtrate add seven parts of ferrous sulphate and a quarter of a part oxalic acid. The sodium sulphindigotate is made by dissolving one part of finely-powdered indigo blue in four parts weight of fuming sulphuric acid, allowing the mixture to stand for twenty-four hours, and then diluting it with water, and adding carbonate of sodium till the acid is almost saturated. The precipitate is well washed, mixed with a small quantity of water, and then added to the ink till the latter assumes a deep greenish-blue colour.

Runge's black writing fluid is prepared by adding one part of chromate of potassium to 1000 parts of a saturated solution of logwood, made by boiling 22 lbs. of logwood in a sufficient quantity of water to give 14 gallons of decoction; to this liquor, when cold, the chromate is gradually added, and the mixture well stirred. This ink is not affected by exposure to water or acids, and does not corrode steel pens like ordinary ink.

Coloured Writing Inks.—Most of the coloured vegetable extracts and the aniline colours used in dyeing serve well as coloured inks. Aniline violet has especially come largely into use as an ink.

Red Ink.—The most permanent colour is a decoction of Brazil wood, to which stannous chloride or cream of tartar and alum has been added, and thickened with gum water. For example, 2 lbs. of ground Brazil wood are added to 3 gallons of vinegar, and the liquor boiled till reduced to 1½ gallon: 1½ lb. of rock alum is then added.

Cochineal inks are far more brilliant, but their colour is less lasting. The best is a solution of carmine in caustic ammonia; it must be kept in well-stoppered bottles. One part of carmine, 120 parts ammonia, with one and a half part of gum-arabic, are, according to Bottger, good proportions.

Blue Ink is made sometimes from indigo and sometimes from Prussian blue as a basis. Stephens' method is to dissolve the latter in an aqueous solution of oxalic acid.

Indian or *Chinese Ink* consists essentially of lampblack formed into cakes by means of some glutinous or adhesive substance, such as gum water. The lampblack is said to be made in China by collecting the smoke of the oil of sesame; and M. Merimee states that the Chinese do not use glue in the fabrication of their ink, but certain vege-

table juices, which render it more brilliant and more indelible upon paper. It is used in China with a brush, both for writing and for painting upon paper of Chinese manufacture; and in Europe for designs in black and white, for which it possesses the advantage of affording various depths of shade, according to the degree of dilution with water.

Marking Ink.—These inks are solutions containing silver, which by means of heat or light, or both, is reduced in the tissues, producing an intense black stain, which with ordinary usage is very permanent. Subjoined is a very common formula. Six drachms of nitrate of silver are dissolved in 3 oz. of distilled water, and as much ammonia is added as will liquefy the precipitate which it at first occasions. A little sap-green, ivory black, Indian ink, or indigo, diffused through 4 drachms of mucilage of gum-arabic, forms the temporary tinctorial matter, and water is added to make up the quantity to 4 oz.

Sympathetic Inks are such as are invisible until heat is applied, and then, by the chemical change induced, the writing becomes visible. The most remarkable of these is that prepared from cobalt, called Hellot's Sympathetic Ink, which is a chloride of the metal. When the written paper is held to the fire so as to evaporate the water, the letters become green.

Printing Ink.—Printing inks are oils of various kinds more or less boiled or otherwise converted into varnishes. The varnish almost universally used consists of linseed oil boiled with great care till sufficiently thick, when it is on cooling thoroughly ground with lampblack, driers of various kinds being added, according to the fancy of the ink-maker. Copper-plate printers' ink is made with oil which is less boiled, and the charcoal used is stated to be Frankfurt black, made from vine twigs.

INLAND REVENUE. The inland revenue is that portion of the revenue of a country which is raised on articles produced or taxed within it, as distinguished from the customs or the duties upon articles imported from abroad. The three great sources of the inland revenue of the United Kingdom are the excise and stamp duties, and the land, income, and assessed taxes.

The excise duties had their origin in the reign of Charles I., when a tax was laid upon beer, cider, and perry of home production. The Act by which these duties were authorized was passed by the Long Parliament. It was adopted and enforced by Oliver Cromwell; and in the reign of Charles II. they were granted as a part of the revenue of the crown. For a long time duties of this class were viewed with great dislike by the people, on account of their inquisitorial interference with various industrial pursuits; and it certainly formed a very strong ground of objection against excise duties, that the security of the revenue they yielded was held to be incompatible with the perfect freedom of the manufacturer as to the processes which he might apply in his works. In every highly taxed country it would, however, seem to be hardly possible to avoid their adoption; much indeed may be said in their favour, as compared with other taxes, when they serve to extract money for national purposes from personal expenditure on luxuries, especially when, as in the case of alcoholic liquors, their excessive use becomes a vice.

In 1797 the number of articles subject to excise duties was twenty-eight, including even such an indispensable necessary of life as salt. In 1833 the number had been reduced to fifteen; in 1835 to ten; and in 1845 there were only nine. In the latter year Sir Robert Peel commenced a reform in the excise laws by repealing the duty on glass, and by substituting a license for auctioneers, instead of the excise duties on the sale. Bricks and soap were subsequently relieved from the impost; and in 1861, after a long struggle, the tax on paper was removed. In 1862 an increased brewer's license was substituted for the excise duty on hops; and in 1880 the excise duty on malt was abolished, and a tax on beer imposed in its place. The only articles, therefore, now subject to excise duty are spirits, beer, and chicory—a duty being imposed on the latter rather with the view of preventing its too extensive use in the adulteration of coffee than of adding very materially to the revenue.

It is manifest that in this country since the repeal of the malt tax the real objections made to excise duties have been almost entirely invalidated; for it cannot be said that a comparatively slight tax on beer and a heavy one on spirits at all interfere with important branches of trade, or sensibly diminish the comfort and well-being of the population at large. There are still, it is true, certain duties to which the name of excise is applied, which can hardly be called duties on consumption, although they are accessory to it, such as the sums charged for licenses to carry on certain trades and professions. The chief danger to guard against in the imposition of excise, as well as customs duties, is fixing the rate so high as to almost offer a premium on smuggling and illicit distillation, and thus defeat the very object sought to be attained—the realization of as large an amount of revenue as possible.

Prior to 1823 there were separate and independent Boards of Excise for England, Scotland, and Ireland, and the total number of commissioners was twenty-one. The business was then transferred to one board of seven commissioners in London, who, in addition to their other duties, held courts and decided summarily in cases of the infraction of the excise laws. In 1849 the Board of Excise was incorporated with that of the Stamps and Taxes, under the name of the Board of Inland Revenue; and breaches against their revenue laws must now be decided by the ordinary legal tribunals. For the management of the country business of the department the whole of the United Kingdom is divided into collections, and these are subdivided into districts, rides, and divisions. There are about sixty collections in England and Wales, and at the head of each is a collector, who visits the principal towns in his circuit four times a year, to receive the duties and transact other business connected with the department; besides which he is required to have an eye generally upon the discipline and efficiency of the service. The number of officers in a collection varies from forty to ninety. The next subdivision of a collection is the district, at the head of which is a supervisor. Next come the subdivisions of the districts into divisions or foot-walks and rides. Where the traders are scattered the officer is obliged to keep a horse, and his circuit is called a ride; but if a large number of traders reside in a smaller circuit they are visited by the officer on foot, and then the subdivision is termed a division or foot-walk. Before going out each day the officer leaves a memorandum at his home, which states the places he intends to survey, and the order in which he will visit them; and the exact time at which he commences each must be entered in his journal. The supervisor re-surveys some of the officer's surveys, but which they will be is of course unknown to the officer; and if errors are discovered they must be entered in the supervisor's diary. These diaries are regularly transmitted to the chief office, and no officer is promoted unless the diaries show him to be efficient. The removal of officers from one part of the country to another was Mr. Pitt's suggestion; it is still acted upon to a certain extent, but, unless in case of promotion, is now generally optional with the officer. At the chief office in London there is a department of surveying-general examiners, who are despatched to any district without previous intimation, as a check upon the accuracy and integrity of the supervisors. Promotions take place in the excise department as vacancies occur, but only when the officer has petitioned for advancement. This involves a rigid examination into his qualifications, which is termed "taking out a charact r."

In Scotland the remote and thinly-peopled parts of the country, where but few duties accrue, are laid out in preventive districts, instead of collections. The supervisor has charge of each of these preventive districts, and acts in the capacity both of a check officer and a receiver of duties. He has under him, in addition to the ordinary surveying officers, a number of preventive officers and preventive men, whose special business it is to aid in suppressing the illicit manufacture of malt and spirits. In Ireland, since the abolition of the revenue police force, the same object is effected by the co-operation of the constabulary with the officers of excise.

Since 1866 the surveying officers of the excise department have been annually employed by the Board of Trade in collecting the statistics of live stock and of agricultural produce in Great Britain. In 1870 the collection of the assessed taxes was also placed in their hands. Previously those taxes had been collected by persons resident in the localities, but totally unconnected with the government and indifferent to the interests of the exchequer; in fact, they had even been somewhat openly opposed to those interests, and engaged in doing their best to thwart the intentions of the legislature. They were many of them illiterate, many corrupt, and for the purpose of instructing them in their duties, and restraining them from doing wrong both to the crown and the subject, it was necessary for the government to maintain another large staff of officers to go over the same ground; and after all that precaution and expense there remained an amount of evasion of taxes which could scarcely be accounted for by mere carelessness or ignorance. So successful did the new system prove, that in introducing the budget for 1870–71 the chancellor of the exchequer stated it was intended to place the collection of the income tax and house duty also in their hands, but this has only been carried into effect in a few places.

The duty of superintending the assessment and collection of taxes is intrusted to three classes of officers, viz. inspectors, surveyors, and assistant surveyors. After a service of twelve months an assistant surveyor is entitled to apply for his commission as a surveyor, when he undergoes an examination in the law and practice affecting the tax revenue. The examination is conducted by the chief inspector, but the candidate's papers are submitted for the consideration of the board, who, if satisfied of his fitness, recommend the lords of the Treasury to grant him his commission.

In filling up vacancies in the lower classes, as a rule, no departure is made from the principle of seniority, but a wide discretion is exercised in selecting officers for promotion to the important districts in the first class. The office of inspector is filled by the selection of the fittest among the surveyors; and as their duties require them to be constantly travelling in all parts of the country and at all seasons, no one is promoted to the position who has attained the age of fifty-five years.

Considerably more than half the public income of the United Kingdom is derived from the various branches of revenue under the management of the inland revenue commissioners. The following were the amounts for 1885:—

Excise,	£26,600,000
Stamps,	11,925,000
Taxes,	2,950,000
Income Tax,	12,000,000
Total,	£53,475,000

INLAY'ING is the art of inserting pieces of one substance in cavities cut in the surface of another, as a means of ornament. The substances may be various kinds of metal, or wood, pearl, ivory, tortoise-shell, &c.; and the product may either be regarded as a work of art, or as an ornament of furniture. Two kinds which had much celebrity in their day, but are perhaps less practised at present, are *buhl* and *reisner* work, so named from two cabinet-makers, Buhl, an Italian, and Reisner, a German, who settled in Paris in the reign of Louis XIV. Buhl mostly used a brass inlay on a tortoise-shell ground; Reisner, a dark wood inlay on a tulip-wood ground; but it is obvious that the varieties admit of almost interminable change. Where the substances are not too hard to be easily cut, the devices are produced by counterpart sawing; that is, two thin plates of wood, of metal, or of wood and metal, &c., are laid one on another, and a very fine saw is worked through both of them, in lines marked out by a pencil device. If we suppose that two veneers or thin layers of wood, one black and one white, were thus treated, there might be two pieces of inlaying produced, the one a black inlay on a white ground, and the other a white inlay on a black ground, for one veneer would exactly fit the holes cut in the other. The saws for this work are mounted by the two ends only in bow or arched handles of sufficient curvature to lie beyond the plate through which the saw is cutting; they are very narrow and thin, and are worked in short quick movements. In buhl work the patterns generally consist of continuous lines; this does not require the actual separation of the brass into small pieces, and thereby marks one point of difference between inlaying and mosaics.

The ornamental stone-work called *pietra dura* bears more resemblance to inlaying than to mosaic, for the holes are cut not through the ground, but only to a certain depth, in slabs of black marble; and small bits of other coloured marble are inserted to this limited depth. The inlaying of knife and fork handles with studs of gold and silver is similarly effected by drilling holes to a certain depth, and inserting fragments of gold or silver wire. The inlaying of *papier-maché* with pieces of mother-of-pearl, or other iridescent substances, is not strictly inlaying in the sense here employed; for the decorative substance, cut into the form of leaves, flowers, or other devices, is laid on the papier-maché, and a general level produced by many thicknesses of varnish. See PAPIER-MACHÉ and MOSAIC.

INLIER, in field geology, is the name applied to an isolated patch of strata surrounded by beds of later geological age. The exposure of the underlying rock is generally the result of denudation, but is sometimes produced by faulting, and not uncommonly by a combination of the two processes. The Ashby-de-la-Zouch coal-field, near Derby—carboniferous beds surrounded by Trias—is a remarkable example of an inlier; also Dudley Hill and the Wren's Nest, near Birmingham, which are formed by Silurian rocks appearing through carboniferous. The term is used chiefly in contradistinction to *outlier*, which is applied to an isolated patch of newer strata surrounded by beds geologically older. An inlier is always surrounded by beds of later date, an outlier by beds of earlier date. The term inlier has sometimes been applied to a lenticular patch of some lithologically different rock in a section.

INN. An innkeeper is responsible for the safety of the goods of persons who use his house; but he may be released from his liability either by inattention on the part of the guest to such reasonable rules as the innkeeper may lay down for the protection of the property of his guests, by any act of negligence on the part of the guest himself, or by his making use of the house not *causâ hospitandi*, that is, not for the purpose of using it as an inn. Thus, if an innkeeper requires his guest to put his goods under lock and key, and the guest leaves them in a passage, whereby they are lost; or the goods are stolen by the guest's own servant; or the guest uses his room in the inn as a show-room, into which a number of people are allowed to have access, and not as a lodging-room, the responsibility

of the innkeeper ceases. By the 26 and 27 Vict. c. 41, "No innkeeper shall be liable for any loss or injury to a guest's property, not being a horse or other animal, or a carriage, to a greater amount than £30, except where such goods shall have been lost, injured, or stolen through the wilful act, default, or neglect of the innkeeper, or any servant in his employ, or where the property has been deposited expressly for safe custody with such innkeeper." The innkeeper may require the property to be sealed. If he refuses to take care of any article, or if he neglects to put up in a conspicuous place a copy of this Act of Parliament, the innkeeper cannot have the benefit of it.

An innkeeper is bound to open his house to all travellers, and provide them with such accommodation as he has, if the person applying is a traveller, able and willing to pay the customary hire, and is not drunk or disorderly or tainted with infectious disease. In return for this compulsory hospitality the innkeeper has a lien upon the goods of his guest for payment of his bill; and, under an Act passed in 1878, he can, after a lapse of six weeks and after due public notice, sell such goods in payment of the board and lodging of the owner. He cannot, however, detain the person himself. In a case tried in 1877 it was decided that there was no contributory negligence on the part of a guest whose watch and rings had been stolen at a hotel, although he had gone to bed without locking his door. A coffee-house, where beds and provisions are furnished, is a common inn, and the keeper thereof is exposed to the same liabilities and has the same protection as an innkeeper.

INNATE TRUTHS or **INNATE IDEAS.** See Idea.

INNISKIL'LINERS or **INNISKILLINGS,** a term in military language applied to the officers and soldiers of the 6th Dragoons and 27th Foot, on account of those two regiments having been originally raised at Inniskillen, a town of Ulster whose inhabitants distinguished themselves in favour of William III. in his contest with James II.

IN'NOCENT was the name assumed by no less than thirteen popes.

Innocent I. was the first great pope. Up to his time the safety of the Roman hierarchy had lain very much in its obscurity; the great forces of Latin Christianity were outside Rome. St. Ambrose at Milan had asserted spiritual supremacy in his excommunication of the Emperor Theodosius for bloodthirstiness, and in his resistance to the restoration of the statue of Victory to the senate-house at Rome, and to the toleration of paganism; St. Jerome had successfully asserted the principle of the celibacy of the clergy, and was now completing the Vulgate, the great Latin translation of the Bible (which has probably done more than any other one thing to establish Roman spiritual authority) in his cell at Bethlehem; St. Augustine at Hippo, in Africa, was elaborating the great system of Latin theology. It was under these circumstances that Innocent I. was elected pope in 402. Only a few years before Jerome had felt sure of election, but fortunately another had been preferred, and he had withdrawn to his higher work. Innocent, not particularly gifted in himself, was firm, astute, ambitious. Like so many of the greater popes he was a Roman, born at Albano, not far from the imperial city. He brought into prominence the group of doctrines that St. Peter was the chief of the apostles, that he had been bishop of Rome, and that the see of Rome was therefore to be regarded as the apostolic see. Much was made, too, of the unbroken series of bishops, in which Rome certainly was superior to any of the other ancient sees. The pope took advantage of the longing for a definite spiritual rule answering to the definite temporal rule of the emperors; nay, further, since as his reign proceeded the Western Emperor Honorius, absent from Rome as he usually was, sank more and more beneath the weight of the troubles of the state, Innocent came forward as the chief personage in Rome, and eventually in Italy. The ancient prestige of Rome—imperial mistress of the world for so many centuries—had not vanished, and combined with the apostolic succession from St. Peter, chief of the apostles, to elevate the Bishop of Rome. The council of Sardica, many years before (in 347), had spoken of the wisdom of appealing to Rome; and this decree, too, Innocent revived from its oblivion. So carefully did he use his opportunities, now persuading the Bishop of Rouen, now exhorting the Bishop of Toulouse (404), now reproving the synod of Toledo or that of Macedonia (405), and in each case assuming a pontifical authority, that eventually, with the large exception of the African churches, he raised this assumption into a fact. Careful never to strain the new authority, he yet established it so firmly that a year or so after his death Valentinian III. by an edict ordered the appeal to Rome as the final arbiter in ecclesiastical matters (421). Innocent had the good fortune to be able to take the lead in an important action of the orthodox church—namely, the repression of the Donatists, who had existed for a century, and for whose downfall St. Augustine had now put forth his whole strength. In 404 Innocent set going the movement which reduced them to impotence—he gathered the laurels which St. Augustine had planted. In 405 again he interfered in favour of the "golden-mouthed one," the peerless orator St. Chrysostom, the unjustly deposed patriarch of Constantinople, and here again the popularity of his cause raised the Bishop of Rome in the estimation of all, besides the plain fact that the chief bishop of the West was in this way clearly seen to be the patron and protector of the chief bishop of the East. A third event, at first sight fatal, in reality proved to be the final cause of Innocent's great rise in power. This was the taking of Rome by Alaric in 408. Alaric the Goth was a barbarian king, but a Christian, though a heretic (Arian), and in taking Rome he dealt the deathblow to paganism. Innocent was in Rome during this first siege, which ended in the capitulation of the city and the payment of an enormous ransom. To make up the sum the statues of the pagan gods were melted down. Innocent retired from Rome. In 409 Alaric took Rome a second time, and set up the Arian Attalus as emperor; but on the city becoming turbulent through famine he took it a third time in 410, and now delivered it over to fire and sack. From the ashes of pagan Rome it was that the supremacy of Christian Rome arose. The basilicas and temples which had escaped the flames were converted to Christian churches, when Innocent returned on the departure of Alaric. Orosius declares that it was like Lot escaping from the fires of Sodom. All the old pagan religious titles then still existent, the Flamens, the Pontifices, Haruspices, and Augurs, absolutely disappeared. Innocent remained alone, the solitary religious authority in the city, and by far the chief temporal power. At the very close of his life he reached the summit of his power, in the great appeal of the church which was made to him to decide upon the Pelagian tenets. He pronounced Pelagius a heretic, and declared that "the unsound limb must be severed without remorse, lest it should infect the living body." Before the answer of Pelagius could arrive Innocent had died. But his work was done, the Bishop of Rome was now in especial the pope (Lat. *papa*, father) of the church. For some time longer other bishops were frequently styled popes; the title was not limited to the Bishop of Rome till the decree of Phocas in 606, but the true starting point of the power of the papacy is from Innocent I.

Innocent II. (*Gregorio Papi* by name) succeeded Honorius II., 15th February, 1130. Innocent was the nominee of St. Bernard of Clairvaux. He had the great majority in Rome against him, though he boasted the

support of the Frangipani, the chief family at Rome, and a strong minority of the cardinals. His partisans elected him in secret, on the day Honorius died; his rival asserted that it was even before Honorius died. The more numerous party waited till after the funeral of Honorius, and then elected the cardinal, Peter Leonis, under the style of Anacletus II. If Innocent was first elected, Anacletus was canonically elected. The strife went against Innocent, who escaped to France, and was received at Cluny, 25th October. He held a council at Clermont in November; for St. Bernard, to whom Louis the Fat, king of France, committed the responsibility of deciding between Innocent and Anacletus, had unhesitatingly supported the former. To Henry I. of England, who still wavered, St. Bernard wrote authoritatively, "Thou fearest the sin of acknowledging Innocent; answer thou for thy other sins, be that upon *my* head!" Finally the Emperor Lothair acknowledged him, and he visited Rheims, where he held a council (1131). In 1132, accompanied by St. Bernard, Innocent returned to Italy, where the emperor met him with an army, and where opposition fell before the mingled authority of the emperor and St. Bernard. In 1133 Innocent and St. Bernard were in Rome, Anacletus still remaining there, but in the fortress of St. Angelo. The rival popes thundered interdicts mutually. The emperor retiring, in spite of St. Bernard's upbraidings, Innocent found himself compelled to retire also, and took refuge in Pisa. It was while he was here that he ratified by letter King Stephen's title to the crown of England (1136). In 1137 Lothair returned and again restored his authority, reducing Anacletus once more to the narrow confines of the Vatican, where his death in 1138 left Innocent at last the undisputed pope. Another antipope (Victor III., so called) was indeed elected, but he submitted in two months, won over by the earnest and disinterested appeals of the saintly Bernard. The second Lateran Council, held in 1139 by the reunited church, was the greatest and most powerful church assembly hitherto seen, and it legislated with irresistible force upon not only all the ecclesiastical, but the moral questions then at issue. Some of its decrees are remarkable, but space forbids to mention more than three as examples. These are—(1) It was made sacrilege to strike an ecclesiastic; (2) tournaments were condemned; (3) the use of the crossbow against Christians and Catholics was pronounced to be a deadly sin and hateful to God. The Truce of God was especially decreed afresh, under penalty of excommunication; war was to cease entirely, from Saturday night till Monday morning, during Advent, the time of Pentecost, Holy Week, and on several fasts and festivals. Thus did Innocent II. earnestly endeavour, directly he arrived at undisputed authority, to reduce the bloodshed of the age. It is an irony of fate that the rest of his reign was spent in constant war. He was taken prisoner by Roger, king of Sicily, 1138, but his patience so charmed his conqueror that the pope won better terms as a captive than he could have hoped to do at the point of the sword. He had, however, to acknowledge Roger as King of Sicily, and to abandon his own feudal claims.

At this time Abelard (whose name is inextricably interwoven with that of Heloise) had advanced to the position of the foremost intellectual teacher, as Bernard was the foremost spiritual teacher, of the time. Abelard's conceptualism, his assertion of the supremacy of reason, could not remain unchallenged. Bernard brought him before the Council of Sens in 1140, and he appealed to Rome. Innocent, who had published a bull in favour of Heloise in the earlier struggles of 1131, now at once, on the demand of St. Bernard, condemned her lover and husband, absent and unheard, 1140. Abelard found a refuge at Cluny, whose walls had sheltered Innocent himself, and died there in 1142.

The close of Innocent's life was amid tumult. The monk Arnold of Brescia had been condemned by the Lateran Council, and banished from Italy. He fled to Zurich. His crimes were the denunciation of the wealth and state of the clergy; he would reduce them to apostolic poverty. He was an ardent pupil of Abelard, and carried his love of liberty onward from philosophy to politics. In 1143 this revered, austere, but popular teacher was in Rome, and the result was the temporary triumph of his doctrines in the withdrawal of all temporal sovereignty from the pope. Innocent had waged war on revolted Tivoli, a quarrel had arisen over the punishment to be inflicted on the conquered town, and the long-smouldering discontent had taken the occasion to burst out. A republic was proclaimed; a senate was convoked in the capitol, and a patrician or governor elected, as in the ancient times of the later empire. The new patrician at once invited the emperor to come and resume his imperial rights as feudal lord. In the midst of this downfall of the papal temporal power Innocent expired, 24th September, 1143. Guido di Castello, the great friend and protector of Arnold, was at once elected as Celestine II.

Innocent III., born at Anagni about 1160, was the son of Count Thrasimund, and received at his baptism the name of Lothaire. After pursuing his studies at Rome, Paris, and Bologna, in which he attained to eminence both as a theologian and jurist, he filled various offices under Lucius III. and Urban III., was elected cardinal by Clement III., and raised to the papal chair, 8th January, 1198, under the name of Innocent III. The greater part of Italy was then subject to the Germans. As soon as he was consecrated, he began his efforts to restore the papal supremacy in Rome and the States of the Church. He absolved the prefect of the city from his oath of fealty to the emperor; established a confederacy of the cities of Tuscany, through whose instrumentality he expelled the Germans to whom Henry IV. had given the territories belonging to the church; and took the Lombardic league under his protection. Frederick, Henry's infant son, was acknowledged as his father's successor in the empire. But Innocent was afraid of so many crowns on one head, and the princes of the empire thought the crown of Charles too heavy for the head of a child. When therefore Constantia, mother of Frederick II., was severely pressed by different parties, she was obliged to renounce all the prerogatives of the Sicilian monarchy, and to accept from Innocent the feudal sovereignty of the Sicilies in order to secure something real for her son. After her death in 1198, Innocent, as the appointed guardian of her orphan child, conducted the government of the Two Sicilies with energy and prudence. Having recovered most of the cities and fortresses in Italy—which, as he alleged, had been rent from the patrimony of St. Peter—he turned his attention to German affairs. When Philip, duke of Swabia, and Otho IV. contended for the empire, he took the side of the latter and terrified Philip with denunciations. The murder of Philip at Bamberg by an offended vassal put an end to the civil war in Germany; and his rival being universally acknowledged as emperor, and having satisfied all the demands of Innocent, was crowned by the latter at Rome in 1209. The two great factions which attached themselves to the church or the empire, to the side of Frederick II. or Otho IV., were afterwards called Ghibellines and Guelphs. As soon, however, as the emperor had attained his object, he began to take measures for the recovery of the imperial rights in Italy. After taking the duchy of Spoleto, he attempted to wrest the inheritance of the young Frederick, Innocent's pupil. In 1211 Innocent excommunicated Otho with all his confederates and assistants. The latter, not terrified, pressed into the papal states, subjugating Apulia and Calabria, and advancing as far as Tarentum. Archbishop Siegfried was therefore commanded, as the papal delegate, to go through Germany, proclaiming the papal ban, and enjoining every

one neither to call Otho emperor nor to render him obedience. Measures were taken for declaring him unworthy of the throne, and the young Frederick II. was substituted in his place. When Frederick appeared in Germany, supported by the pope and the King of France, most of the states declared in his favour; and he was therefore crowned at Aix-la-Chapelle in 1215. Otho, forsaken by fortune, retired to his Brunswick possessions.

Other emperors and kings also experienced the power of Innocent. Philip Augustus, king of France, had dismissed his wife Ingeburge, and married another. When he paid no heed to the admonitions of the pope, his country was put under an interdict in 1200, which was not removed till he received back his former wife in 1201. In the same way Innocent dealt with Alfonso IX., king of Leon, when he refused to divorce his wife. He also withheld his consent from a similar marriage of the King of Aragon, who, under the title of Peter II., was crowned at Rome, after rendering his dominions tributary to the church. John, duke of the Bulgarians, received his crown and sceptre from Rome. Sancho I. of Portugal, after resolutely denying it, finally acknowledged the validity of the document in which his father had made the kingdom tributary to St. Peter's successors. But John, king of England, humbled himself the lowest. When Stephen Langton was elected and consecrated archbishop of Canterbury in 1207 by Innocent, the king opposed the election. Hence the pontiff excommunicated him, and put his realms under an interdict. Divesting him of all authority, he gave England and Ireland to Philip Augustus, king of France. Terrified and dreading a war, John made his dominions tributary to the pope in 1212. Innocent, deeming the violence done to John in obtaining Magna Carta as done against the holy see as lord paramount, threatened the barons and bishops with excommunication. But they held firmly to their purpose. Innocent appointed a Latin patriarch of Constantinople after the city had been occupied by an army of the crusaders, and Count Baldwin of Flanders had been elected the first Latin emperor. Innocent had nothing to do with the treacherous proceedings in relation to Constantinople. The fourth Lateran Council, held in November, 1215, was one of the most imposing. There the representatives of Christendom were gathered around Innocent to take measures for reconquering Palestine, exterminating heretics, and reforming the church. In it seventy canons were ratified, relating to matters of faith, jurisprudence, and discipline. All heretics were the subjects of unsparing rigour throughout his official life; for he sent legates intrusted with full powers to suppress heretics in the south of France, who went about barefooted, exhorted, argued, set up courts of trial, and employed all measures against the disobedient. [See INQUISITION.] The Lateran Council was equally severe against heathens, as the Mohammedans were then called. It also placed restrictions on the intercourse of Jews with Christians, while they and Saracens were commanded to wear a peculiar dress. The most important regulation of the council was that which confirmed the two new orders of Dominicans and Franciscans. In short, papal authority celebrated its jubilee at this council, when Innocent could compare himself to the sun and royalty to the moon, borrowing its light from the greater luminary. From the time of the council till his death, Innocent longed to exercise the duties of the pastoral office, and preached often. His discourses were figurative and in the style of the Old Testament. He died on the 16th of July, 1216. Innocent was learned according to the age, laborious, earnest, energetic. Though rich he did not indulge in luxury, but subordinated wealth to the great ruling passion of his life, that of exalting the spiritual above the temporal power. His wealth was not hoarded up in the spirit of a miser, but freely spent on behalf of the poor and the crusades. It must also be stated that he was a father to widows and orphans, a steady friend, and sometimes a peacemaker between princes and their subjects. He certainly contributed more than any other pope to enlarge the dominion of the Roman see. Besides his letters, Innocent wrote a number of tracts and discourses, chiefly practical; a commentary on the seven penitential psalms; three books on contempt of the world; and six books on the mysteries of the mass. The epistles, in nineteen books, were republished by Baluze, in two vols. folio (Paris, 1682). His works first appeared in 1552 and 1575 at Cologne.

INNOCENT IV. (*Sinibaldo de' Fieschi*) was made a cardinal by Gregory IX. in 1227. The long contest waged between Gregory and the Emperor Frederick II. is elsewhere fully described. [See GREGORY IX. and FREDERICK II.] At Gregory's death Celestine IV. was elected; thirteen days later he died. Frederick vainly urged the cardinals, who fled from Rome, to choose a successor, so that he might be relieved from the excommunication of Gregory. He lost all patience, advanced on Rome, and seized the estates of the cardinals, after the see had been vacant for two years. This measure forced an election. In terror the cardinals met at Anagni, and elected the greatest partisan Frederick possessed among them, Cardinal de' Fieschi. Some one congratulated Frederick. "Ah no!" he replied, "in the cardinal I have lost my best friend, in the pope I shall find my worst enemy. No pope can be a Ghibelline" (an imperialist). The cardinal fulfilled his prophecy by the significant hint he gave in choosing his pontifical name. Innocent III. had been the scourge of princes. He took the title of Innocent IV., 24th June, 1243. At first he responded freely to Frederick's overtures, and in March, 1244, signed a treaty with him. This lasted exactly one month. The hostilities which began in April between Innocent and Frederick, resulted in the pope's flight to France, or rather to the city of Lyons, then a free city of the empire, proclaiming a crusade against the emperor as the common enemy of Christendom (1246) at the Council of Lyons, in spite of the counsels of the saintly Louis of France. Innocent's life was attempted after this proclamation. His suggestion of a visit to England met with a rough rebuke from the revolted barons of Henry III., "We do not want the pope to pillage us." His exactions had been so excessive that his collector had been summarily ejected by the barons.

The pope's anger against the empire did not cease with Frederick's death. Innocent at once returned to Italy, and was followed as swiftly by Conrad. The pope struck boldly for the kingdom of Sicily. He pursued Conrad with the same hostility as his father. He was not strong enough in arms to eject Conrad, who, excommunicate though he was, was received either with open arms or as an easy conqueror. Innocent looked round therefore for support, and fixing on the wealthy and ambitious Richard, duke of Cornwall, brother of Henry III., he offered him the crown of Naples. Richard was too prudent to accept it; but the vain and feeble king welcomed the offer for his son Edmund, who received investiture from the pope, was saluted as king at court, and whose hoped-for entry into his kingdom was sought to be provided for by large subsidies which Henry forwarded to Innocent. He taxed, he begged or forced loans, he robbed the exchequer for this purpose to such an extent that it was greatly the cause of the revolt of the barons and the battle of Lewes. Conrad dying in 1254, the sovereignty passed to his young son Conradin under the guardianship of his uncle Manfred, an illegitimate son of Frederick II. By enormous exertions a great army was gathered under the banners of the warlike pope. As it advanced Manfred found his adherents waver. He at once sent in his submission to the pope, who was delighted to receive the homage of the first captain of the age. Innocent advanced to Naples, loading Manfred with honours,

the better to secure him. But Manfred learnt that a deep plot existed against his liberty, probably his life also. He fled to Lucera, where the Moorish subjects of his late father received him gladly, and he begun to gather a few forces. Innocent, thoroughly alarmed, and as regardless of his sale of the realm to Edmund of England as of the price which he had received at so great a cost to the father of the purchaser, now sold it for the second time to Charles of Anjou, brother of the King of France. But hardly had he completed this transaction when he died, 7th December, 1254. One of the last bulls issued by Innocent IV. was the celebrated bull submitting the Franciscan and Dominican friars to the control of the ecclesiastical authorities. The Dominicans openly prayed for deliverance from so wicked a pope—whence, says the ancient chronicle of Siena, the proverb arose, on the speedy death of Innocent, "From the litanies of the Dominicans, O Lord, deliver us!"

INNOCENT V. (*Pietro di Tarantasia*), elected in February, 1276, in succession to Gregory X., died in the following June.

INNOCENT VI. (*Etienne d'Albert*) was created cardinal of Ostien, 1342, and succeeded Clement VI. as pope 18th December, 1352, during the exile of the papacy to Avignon. His accession was amid the horrors of the black death and the triumphs of Edward III. of England, which added the desolation of war to that of the plague. His first act was to annul the decision of the conclave assembled after Clement's death (although he had himself sworn to it), limiting the number of cardinals to twenty, and requiring the pope's election of new cardinals to be confirmed by two-thirds of the existing college. This arrangement, as Innocent was wise enough to see, would have reduced the pope to the position of the later doges of Venice, a mere agent of the will of a superior oligarchy. Innocent attempted to raise the papacy from the luxurious sloth into which it had fallen. He insisted upon the clergy returning to their benefices, and sent Cardinal Albornoz to Italy to prepare for his own return. A chaplain came to him, as he would have done to Clement, asking for a benefice for his nephew. "Let him take one of the seven benefices which you hold," said the pope (as reported by Balus); then going on, he said, "Retain three for yourself, and with the remaining three I will reward some poor and deserving clergy." Albornoz recovered the greater part of the Italian papal dominion in 1353, Rienzi being taken by him from his Avignon prison to become the senator or governor of Rome, where he died in 1354; and just before his death Innocent was gratified with the full submission of Rome on the one condition that Albornoz should not rule there. Innocent died 12th September, 1362, and was buried in the magnificent tomb which still forms one of the glories of Villeneuve, the fortified *tête du pont* opposite Avignon. Innocent VI. lent all the force of his wisdom and of his authority to procuring the peace of Bretigny, which stayed for a time the continual bloodshed between England and France. He came very near also to a chance of reuniting the Eastern Church with the Church of Rome; for the Eastern emperor, John Palæologus, offered his submission in exchange for succour against the usurper Cantacuzenus. Innocent, however, could not find either money or troops beyond what his own urgent necessities required. He was one of the most powerful and prudent of the popes of this epoch, as his successor Urban (the first to return to Rome) was the most pious.

INNOCENT VII. (*Cosimo de' Megliorati*), Cardinal of St. Croix, 1389, succeeded Boniface IX. as pope, 17th October, 1404, in the time of the great schism. He swore, as did all the other cardinals, to abdicate the papal throne, if elected, so soon as the antipope, Peter di Luna, called Benedict XIII., should agree also to abdicate, so that the reunited church should elect a pope acknowledged by all. This chance, however, did not come to him. He had too much virtue and gentleness for the troublous times. A sanguinary revolt drove him from Rome to Viterbo for refuge at the end of 1405, but in a few months the city itself invited him to return. He died 6th November, 1406.

INNOCENT VIII. (*Giovanni Battista Cibo*) sprang from a noble family of Genoa. He became cardinal in 1473, and succeeded Sixtus IV. as pope in 1484, at the age of fifty-two. His public acts present a curious medley. In 1485 he preached with great fervour a crusade, but accepted 40,000 ducats from the sultan as the price of important services to him. In 1486 he issued a bull confirming Henry VII. as King of England. In 1487 he issued the famous bull against witches, called the *Malleus maleficarum*, appointed Torquemada grand inquisitor of Spain, and preached a crusade against the Waldenses for their heresies. His private life is not so complex; the only thing to be said for him is that he lived in bad times. He is said to have had sixteen acknowledged children, and took every advantage his position afforded to provide comfortably for them. Innocent died 25th July, 1492.

INNOCENT IX. (*Giovanni Antonio Facchinetto*) reigned from October to December, 1591. He was very aged when he was elected, and the warlike exhortations he issued against Henry IV. and the Huguenots of France sounded strangely from the couch of a dying man. He was succeeded by Clement VIII.

INNOCENT X. (*Giovanni Battista Pamfili*) was seventy years old when he reached the papal chair as successor to Urban VIII., 15th September, 1644. His only important act was the condemnation of the Jansenist propositions in 1653. He was a cheerful, amiable, industrious old man, and merited respect. Unhappily his easy nature gave way to the imperious nature of an ambitious and very capable woman, Olympia Maidalchina of Viterbo, his brother's wife, to whose wealth he had himself owed as a young man his advancement. The lady received ambassadors on their arrival, foreign courts loaded her with presents, nothing could be done without her, nor without amply paying her for her services. Her appointments all bore a stipulated commission on their value. The reputation of Innocent unduly suffered by these arrangements, of most of which he was quite ignorant. He died 5th January, 1655.

INNOCENT XI. (*Benedetto Odescalchi* of Como), cardinal in 1647, became pope as successor to Clement X. in 1676, at the age of fifty-five. He had been a soldier as a young man, and changed his career at the advice of a cardinal, probably Innocent X. Innocent was a man of such remarkable humility, that in calling his servants he would append the proviso "if they were at leisure," and of such exemplary piety that his confessor declared he had never discovered anything in him which could estrange the soul from God. He was as earnest and as conscientious as he was gentle and pious—one would say a perfect pope. Repeated attempts have been made to canonize him, but hitherto French influence has prevailed against the official confirmation of the popular view of his sanctity. Innocent found a deficit of 170,000 bajocchi yearly, and at once met this by depriving all kinsmen of recent popes of their posts attained by favouritism. Many places were abolished. In a very few years the expenditure was not only met but surmounted by the revenue, and that though many taxes were substantially reduced. He incurred not only the lifelong enmity of France, but an enmity lasting to our own times, by his equal firmness against the tyranny which Louis XIV. was exercising against the Jansenist clergy. From this arose a claim on the king's side for the liberty of the Gallican Church to set its own house in order, and on the pope's side for the supremacy of Rome. Louis sent his ambassador to Rome in 1687 with such a retinue that it amounted to an invasion. Innocent excommunicated the ambassador for his illegal seizure of parts of the city. Louis retorted by measures directed towards raising the

archbishopric of Paris into a patriarchate, and by the seizure of Avignon, a papal territory. Innocent left thirty-five French bishops without canonical institution. It was indeed a schism of large proportions, and yet the pope, strong in his rectitude, held on. The same truth to his order led him to confirm the judgment of the Inquisition against the Molinists in 1687, a proceeding which must have cost him much, directed against men of religious enthusiasm so nearly akin to his own. For a year or so before his death (10th August, 1689), he had supported substantially the expedition of William III. against James II. of England—a Protestant against a Catholic—a proceeding which at first sight is inexplicable, until we remember that the Stuarts were mere pensioners of France, and that under them England was a powerful ally of Louis XIV. In fact, it was from a French spy at Rome, in the office of Count Cassoni, Innocent's secretary of state, that James and Louis first learnt, at the end of 1687, that the malcontents in England meant to dethrone James in favour of the Prince of Orange (William III.)

INNOCENT XII. (*Antonio Pignatelli*) is separated from Innocent XI. only by the short reign of Alexander VIII. He was chosen by the great exertions of the French to secure a peace-pope; and although Louis XIV. had eventually to give way before the tenacity of the pope and withdraw his assumption of independence, the schism was healed in 1693. Innocent XII. reigned from 1691 to 1700. He was a benevolent, gentle ruler, but of great firmness; a worthy successor of the saintly Innocent XI. He even went further than his predecessor in reforming nepotism, and in 1692 issued a bull prohibiting for ever any pope from bestowing any estate, office, or revenue whatever upon relatives.

INNOCENT XIII. (*Michael Angelo Conti*), the friend and protector of the Old Pretender (son of James II. of England), reigned from 1721 to 1724. He succeeded Clement XI. His pontificate was marked by his strong anti-Jesuit feeling. He even prohibited the order from enrolling new members, and stopped their famous Chinese missionary work. He refused, however, to annul his predecessor's *Unigenitus* bull of 1713, which condemned the doctrines of the Jansenists, the Jesuits' great opponents.

INNOM'INATE BONE, ARTERY, VEIN. These "unnamed" parts of the body are thus nameless probably because the first is irregular almost to shapelessness, and the latter are but the junctions of great vessels in their course to or from the heart. The two *innominate bones* are made up of bones distinct in infancy, but which unite in the adult subject to form the two sides of the pelvis or hip-girdle. The pelvis may therefore be said to be formed by the two innominate bones; but it is more usual now to treat the several parts of the innominate bone as separate bones. The pelvis is figured and described under BACKBONE. The *innominate artery* is the largest trunk given off from the aorta at its arch, when having risen from the heart it turns and descends. It divides, after a course of only about 1½ inch, into the two main arteries of the right side of the head and arm respectively (the carotid and subclavian); the left carotid and left subclavian issuing from the aorta direct, without any joint trunk such as the arteries of the right side possess in this short innominate artery. The *innominate veins* are also large short vessels at the root of the neck, collecting the blood from the right and left subclavian and carotid veins respectively, draining the head and arms; but they do not discharge separately into the heart, they join together to form the short *vena cava superior*, which discharges the entire blood of the head and upper extremities into the right auricle of the heart, the great *vena cava inferior* bringing into the same chamber the blood from the body and the lower extremities.

INNS OF COURT. These, according to Stowe, were originally the hostels founded by the lawyers in attendance on the Court of Common Pleas when that court was, in accordance with the provisions of Magna Carta, fixed at the palace of Westminster. Of the earliest of these inns one called Johnson's Inn is said to have been at Dowgate, another at Fewters or Fetter Lane, and a third at Paternoster Row. In the course of time these establishments gave place to more important foundations, and Fortescue, chief-justice of England in the reign of Henry VI., enumerates only the four inns of court now existing—viz. the Inner Temple, the Middle Temple, Lincoln's Inn, and Gray's Inn.

The Inner Temple, as well as the Middle Temple, owes its name to the Knights Templars. After the dissolution of that order in 1312 it was granted to the Knights of St. John of Jerusalem by King Edward III., and was soon afterwards (1346), according to Dugdale, demised by them to "divers professors of the common law that came from Thavie's Inn, in Holburne." The church, which is common to both societies, was founded by the Templars upon the model of that of the Holy Sepulchre at Jerusalem, and was consecrated in 1185, and dedicated to the Virgin Mary.

Lincoln's Inn occupies the site of the palace of the Earl of Lincoln. It possesses a fine modern hall and library, built in the Tudor style.

Gray's Inn is so called from having formerly belonged to the family of Gray or Grey de Wilton. Lord Bacon was a member of Gray's Inn.

Each inn of court is governed by its benchers, who fill up the vacancies of their own body. The benchers of each inn exercise the power of calling to the bar the members of their own inn. They also exercise the power of disbarring a barrister, that is, depriving him of his degree of barrister.

The inns of court combine together to form the council of legal education, an examining body which has framed regulations for the admission of students, the "keeping of terms," and the conduct of examinations.

INNS OF CHANCERY.—Besides these four inns of court there were until recently eight inns of chancery—viz. Clifford's Inn (founded 1345), Clement's Inn, Lyons' Inn, New Inn, Thavie's Inn, Furnival's Inn, Barnard's Inn, and Staple's Inn. Ten of these inns are mentioned by Fortescue, in whose age common-law students usually passed some time at them in order to become acquainted with the practice of the High Court of Chancery. These inns of chancery have now no students, and their members are mostly solicitors who meet solely for convivial purposes. Clement's Inn, Barnard's Inn, and Staple Inn no longer exist as corporate bodies, as their members sold the properties of the inns in 1884, and divided the proceeds among themselves. Serjeants' Inn was exclusively devoted to those who had been called to the degree of the coif, an honour which every judge of necessity obtained; but when the distinction of serjeant was practically abolished in 1875 the inn was sold, and the then existing serjeants divided the amount realized.

INNS'BRUCK or **INNSPRUCK**, a town of Austria, the capital of the Tyrol, is situated on the Inn, near the point where that river is joined by the Sill, 245 miles W. by S. from Vienna, and 60 miles N. of Munich, and has 18,000 inhabitants. The town is built in a most beautiful situation in the middle of the valley of the Inn, which is hemmed in on both sides by mountains varying from 6000 to 9000 feet high. It takes its name of Innsbruck (Inn's Bridge) from the wooden bridge which formerly spanned the river, and on and near which the Tyrolese, under Hofer, after a fierce action, succeeded in repulsing the French during the war of independence. An iron bridge supported on granite buttresses now occupies its place. A handsome chain suspension bridge has also been erected. The town is in general well built; many of the houses are in the Italian style, the basement story consisting of arcades,

which are occupied as shops. The street of Neustadt is the finest; here are the Landhaus, or Tyrolese Parliament House, the post office, and at its southern extremity a triumphal arch erected by the Empress Maria Theresa. Among the public buildings the most interesting is the Franciscan church, which contains the tomb (but not the remains) of Maximilian I., the most splendid monument of the kind in Europe, and the Silver Lady-chapel. The twenty-eight bronze statues that form part of its plan and represent some of the worthies of Europe, including the most distinguished personages of the house of Austria, were cast by Tyrolese artists; the bas-reliefs on the tomb and in the Lady-chapel, which are masterpieces of art, were the work of Collin of Mechlin. On the left of the entrance to this church is the grave of Hofer, who so nobly defended his country against the French in 1809, until betrayed by one of his associates and shot at Mantua by order of Napoleon. It is surmounted by a statue of the hero in Tyrolese white marble. The other remarkable buildings are—the Maria Theresa Palace, built in 1770, in the courtyard of which stands an equestrian statue of Leopold V.; the university, in which is the Museum Ferdinandeum, rich in Tyrolese minerals, fossils, and works of art; the Capuchin church, containing the penitential cell of Maximilian II.; the richly decorated Church of St. James (Jacob's Kirche); the old palace of the counts of Tyrol; and the Fürstenburg, with its famous golden roof (*goldene dach*), a sort of oriel window covered with a roof of gilt copper, which projects in front of the building. The public cemetery (Gottes-acker) contains some fine monuments. The market-place of Innsbruck presents a very interesting appearance, from the great variety of picturesque costumes worn by the inhabitants of the different valleys who frequent it. The chief manufactures of the town are silks, gloves, calico, ribbons, glass, sealing-wax, and wood and horn carved work; there is also an important transit trade between Italy and Austria. The neighbourhood abounds with beautiful scenery and charming promenades.

INNUEN'DO, in ordinary conversation, is an indirect hint. It is from the gerund of the Latin *innuere*, to nod at. By speaking covertly, as it were "with a nod and a wink," much scandal may be conveyed, and yet no definite accusation will have been brought, and oftentimes no person named. The innuendo is a dastardly oratorical weapon, used only by cowards

> "Willing to wound and yet afraid to strike,
> Who hint a doubt and hesitate dislike."

In its legal meaning it is that part of the pleadings in cases of libel and slander which makes clear the nature of the attack made, and against whom it was directed. Frequently, as might be anticipated, the legal and ordinary meanings coincide, for an innuendo is the true weapon of the ordinary slanderer.

INOCULA'TION is the insertion of a morbid fluid formed in the body of one person into that of another. It has, however, been more particularly applied to the practice of producing small-pox by removing a small quantity of the fluid formed in the pustular eruption on the skin of one person, and inserting it beneath that of another. The disease is much mitigated by this process. The practice was introduced into this country by Lady Mary Wortley Montagu about the year 1721, her son having thus received the disease during her residence in Constantinople. It had long been practised in Turkey and other Eastern countries. It was very slowly adopted in this country, and it was not until it had been practised on six criminals (whose liberty was promised to them if they recovered, as they fortunately did) that it received the sanction of the medical profession, which was publicly made known by the inoculation of two children of the then Princess of Wales. After this it was almost universally had recourse to, but the results were found by experience to be very unsatisfactory. The disease was maintained and spread by the practice, and whereas the deaths from small-pox at the beginning of the eighteenth century were reckoned as one-fourteenth of the total number, the proportion had risen by the close of the century to one-tenth. In 1796 Jenner introduced the practice of inoculation with the matter of cow-pox, and this quickly superseded the earlier practice. See VACCINATION.

INOCULATION, in horticulture, is only another name for the operation called BUDDING. The season for performing the operation is, generally speaking, from the beginning of July to the middle of August, the particular time varying according to the season. The best criterion is the state of the buds and the degree of cohesion between the bark and alburnum of the stock. If the buds on the young shoots have become so far perfectly formed outside as to bear separation from the branch, and if the bark of the stock can be freely raised, and exhibits an abundance of cambium in a fluid state, the operation may be proceeded with. If, on the contrary, the bark adheres rigidly to the alburnum, or is *set*, as it is technically expressed, there is little chance of success. The operation of budding or inoculation is performed in various ways; but the best and most general is that called shield-budding or T-budding, from the resemblance of the two cuts made in the bark of the stock to the two bars of the Roman letter T.

IN'OSITE, a sugar isomeric with glucose, having the formula $C_6H_{12}O_6$. It was first discovered in the muscle of the human heart, and is found also in the brain, liver, kidneys, and other organs. It is also found in the common pea, cabbage, dandelion, asparagus, and many other plants. It is obtained in crystals, having the formula $C_6H_{12}O_62H_2O$; on heating to 100° C. (212° Fahr.), the water is given off, and at 210° C. (410° Fahr.) it melts to a colourless liquid, which solidifies in crystalline form on cooling. The taste is very sweet, and it has no action on polarized light. When evaporated with nitric acid, and ammonia and calcium chloride added, it forms a characteristic rose colour. It is very soluble in water, but insoluble in alcohol and ether. It differs from glucose in not reducing Fehling's solution (potassio-cupric tartrate), in giving no colour with caustic potash, and in being unfermentable. When dissolved in strong nitric acid, and sulphuric acid added, nitro-inosite is precipitated in a crystalline mass, insoluble in water, but soluble in alcohol. It detonates when struck with a hammer. The formula is $C_6H_6N_6O_{18}$ or $C_6H_6(NO_2)_6O_6$.

IN'QUEST, INQUISI'TION. See CORONER.

INQUI'RY, COURT OF. This is a court on some occasions directed by the crown to be held, the object of which is to ascertain the propriety of resorting to ulterior proceedings against any party charged under the Mutiny Act.

INQUISI'TION, THE (Lat. *inquisitio*, a seeking for), the name of a tribunal in the Roman Catholic Church, instituted originally to seek for and repress heresy and certain open crimes against faith or religion, such as apostasy, a feigned profession of Christianity, blasphemy, and the practice of sorcery, witchcraft, and magic. This tribunal, as such, was called distinctively the *Holy Office.* We have said originally such was the professed object of the first inquisitorial tribunals established by the popes in the thirteenth century. This is properly known in history as the Papal Inquisition. The inquisition, as it existed in Spain after 1481, differed widely from the former, and should not be confounded with it.

1. *The Papal Inquisition.*—The disorders said to have been committed by the Albigenses, Patarini, Cathari, and other sects in the west and south of France at the beginning of the thirteenth century, gave occasion to the

appointment by Pope Innocent III. of persons armed with legatine authority, and charged to search for and repress all such opinions and excesses. It has been thought, but without sufficient foundation, that the first inquisitor-in-chief was St. Dominic, and that he was the first who advised the pope to establish this species of tribunal. But when Dominic and his friend Diego, bishop of Osma, appeared in 1206 as missionaries among the disturbed populations of Languedoc, Peter de Castelnau was exercising against the Albigenses the functions of papal legate and inquisitor. In 1208 Peter was assassinated by a servant of Raymond, count of Toulouse, the mainstay of the Albigenses. The pope thereupon authorized a crusade to be preached against the count and his party. The war, carried savagely on by Simon de Montfort and an army composed in great part of greedy and reckless adventurers, lasted from 1209 till 1227. From the beginning it degenerated into a bitter partisan and political conflict. In 1229 the tribunal of the inquisition, in its first rudimentary form, was established by Gregory IX., who decreed that in every parish a priest and several respectable laymen should be appointed for the purpose of seeking for heretics and bringing them before the bishop. The bishops, however, declined the responsibility of sitting in judgment on such difficult cases; and the Dominicans or Friars-preachers, founded in 1215, were intrusted with this task. Innocent IV., who gave its final form to the Papal Inquisition, made the Franciscans share its labour with the Dominicans. Still to the latter order belong by far the greatest number of inquisitors. In 1542 Paul III. created a special board of twelve cardinals, called the Congregation of the Holy Inquisition, and specially charged with guarding the purity of the faith. This congregation was also a supreme court of appeal to which, in former times, all appeals from the decisions of the inquisitorial judges throughout Christendom were directed, the pope himself generally presiding and always ratifying the final sentence. At present this supreme court only takes cognizance of doctrinal matters. The canon law declares that inquisitors have power to constrain all magistrates, even secular magistrates, to cause the statutes against heretics to be observed, and to require them to swear to do so; also that they can compel all magistrates and judges to execute their sentences, and these must obey under pain of excommunication. This, of course, points to the time when the civil governments were in close union with the ecclesiastical. This was the case from the time of Constantine the Great, all through the existence of the Frankish and Germanic empires, down to the Reformation. Such a union now exists nowhere. But the principles on which both the early imperial legislation against heretics and that of mediæval times were based must not here be overlooked. The Albigensian and Manichæan opinions, together with their professors, had been rigorously proscribed in the Greek Empire before they found a refuge on both sides of the Alps. All through these ages it was sufficient for the bishops to pronounce that a doctrine was heretical, in order to see its professors proscribed and repressed by the civil magistrate. On the radical power of the church itself to repress by coercive measures either heresy or scandalous conduct, very contradictory opinions were held. The Gallican historian, Fleury, maintained with Marsilius that the supreme pontiff, for instance, could only coerce evil teaching and evil-doers when authorized to do so by the emperor or supreme civil ruler. This view is that of an insignificant minority as compared with the great body of canonists and theologians who teach that the church is armed with an inherent coercive power necessary for the protection of the purity and integrity of her doctrine, as well as of the spiritual life of her members. In the manner of proceeding against heretics, two things are carefully to be distinguished—the part performed by the ecclesiastical judge or inquisitor, and that which devolved on the civil power. The criminal code of every country in Christendom, down to the last century, prescribed the use of the torture in obtaining testimony. Every nation used cruel punishments not only toward the greatest criminals, but toward persons found guilty of what we now consider to be minor offences. Forgers and parricides had their right hands cut off. Persons coining and passing false money were burned at the stake. Indeed this terrible form of capital punishment was awarded to a variety of crimes. The annals of religious persecution in the British Islands, as well as on the Continent, are records of atrocious tortures and sufferings inflicted before conviction, often on mere suspicion and most untrustworthy evidence. In the wars against the Waldenses, Albigenses, Cathari, Patarini, &c., on both sides of the Alps, cruelties were committed by each party, as it happened in the long civil wars of England. The greatest severities practised against heretics in Northern Italy happened in the early part of the thirteenth century, when they were often treated as rebels by the civil authorities. After this period very little blood was shed in the Italian cities for crimes against religion. In Bologna, for instance, only a single execution ever occurred. The inquisition in the Papal States was mild in its dealings with heretics. The inquisitors were instructed, in visiting the districts assigned to them, to announce in the most public manner the purpose of their mission. This, however, was only done while the great Albigensian agitation was at its height. The inquisitors declared themselves to be bound under the severest censures to do their duty. All persons professing erroneous opinions were given a fixed period within which they might appear, repent, be absolved, and subjected to public penance. Where the persons thus abjuring had taken a conspicuous part or given great scandal, the penances inflicted were severe, and precautions were taken against their beginning again their former courses. To those who were considered to have been only led astray great indulgence was to be shown. The period of grace over, proceedings were instituted against the contumacious. As was the custom in the courts of the age, oral and written testimony was taken. The inquisition, in taking preliminary informations and examining witnesses, had two priests for assessors, and a notary to register the depositions. It was the duty of the civil magistrate, on the requisition of the ecclesiastical court, to bring the accused to judgment. They were arraigned before the bishop of the diocese, who was the ordinary judge of doctrine within his own jurisdiction and the protector of his diocesans. Torture was only resorted to when there was convincing testimony against the accused and they continued obstinate. Such was the universal custom of the age. Where the testimony, without being convincing, afforded ground for strong suspicion, the accused were declared to be "suspected of heresy," and placed under surveillance. Persons convicted of heresy, when obdurate, were handed over to the civil courts, and sentenced to be burned at the stake. Such was the punishment for heresy, inherited from the Greek Empire.

When convicted and repentant a distinction was made; notorious and leading heretics were imprisoned for life; others who had been seduced and were not likely to seduce others, were dealt with more leniently. One class, that of the "relapsed," was treated with inflexible rigour. This, as the name implies, was composed of such as had been once convicted of heresy, had professed repentance, been pardoned, and then fallen back into their former courses. The ecclesiastical judges, on the conviction of such persons, were bound to hand them over to the civil power to be dealt with according to the utmost rigour of the laws.

The inquisition, thus constituted, was introduced in succession into Italy, Spain, Germany, and France. So-

long, moreover, as this constitution remained, it must be regarded as a strictly papal tribunal. Accordingly, over the French and German inquisition of the following century the popes exercised full authority, receiving appeals against the rigour of local tribunals, and censuring or even dismissing the inquisitor for undue severity. In France the inquisition was soon discontinued; and though an attempt was made under Henry II. to revive it against the Huguenots, the effort was unsuccessful. It fell into disuse in Germany at the Reformation. In England it was never received, all proceedings against heresy being carried on in the ordinary tribunals. In Poland it was established in 1327, but had only a brief existence. In Rome and the Papal States it has never ceased, though its history presents few cases of extreme rigour and cruelty.

2. *The Spanish Inquisition.*—According to Don Joaquin Guichot, the latest historian of Seville and *Cronista Official* of Andalusia, the inquisition, as modified and organized in Spain after 1478, was "a police tribunal controlled by the government." This agrees with Ranke's assertion that the Spanish inquisition is "a royal tribunal furnished with spiritual weapons." For several years before 1478 there had been a great outcry against the converted Jews and Moslems, who, it was alleged, while outwardly professing to be Christians, were secretly fulfilling the practices of their former worship, and exercising a wide and active proselytism. This was the cry raised by the clergy. The nobles, on the other hand, complained bitterly of the usurious practices and intolerable exactions of the Jews in general. St. Ferdinand (Ferdinand III.), as well as most Spanish kings, had intrusted to Jews the management of the royal household and finances; and the great nobles had imitated this example. In the fifteenth century, in the reign of the Catholic kings especially, the frequent wars and expensive habits of the aristocracy placed them hopelessly in the power of their Jewish creditors. Hence the favour which the popular outcry against both alien races found among the higher classes. Guichot, in vol. iii. of his "History of Seville," gives these as the occasional causes that led to the establishment in that city and throughout Spain of the inquisition under its new form. The clergy had good reason for accusing the converts of hypocrisy and proselytizing practices; the nobles felt grievously the burden of debt they had to bear; and the people, who loved neither Jews nor Moors, and suffered from the exactions of the former, were excited in more than one locality to riotous demonstrations against them. King Ferdinand, who loved money, willingly lent ear to the petition for rigorous inquisitorial proceedings; the wholesale confiscations, which he foresaw, would replenish the royal exchequer. The nobles welcomed the project as one likely to rid them of debt and creditors. Such are the motives assigned by contemporary writers for the institution of the Holy Office in Southern Spain under a new and more terrible form. Queen Isabella's gentle and liberal disposition resisted the efforts made to obtain her sanction. At Rome a reluctant answer was given by the pope, who, as original documents prove, was only moved by the dangers to religion pointed out to him. Even when the papal bull of institution was issued by Sixtus IV., Isabella still resisted. And when she yielded a conditional assent, she demanded that two whole years should be given to warning the Jews and Moors of their danger, and to making strenuous and general efforts to instruct them in the truths of the gospel. Zealous and edifying preachers were sent by her orders into city and country to enlighten and warn the erring, and to persuade them to save themselves from coming evil. In 1480, at the end of this term of grace, two Dominicans were appointed inquisitors in Seville, and the convent of St. Paul in that city was made the seat of the Holy Office. A number of important persons were imprisoned there, and detained for a long time without trial. At length the citizens assembled, broke open the convent doors, and set the prisoners free. This led to removing the seat of the Holy Office to the Castle of Triana, on the opposite side of the river. The inquisitors were spurred by this occurrence into extraordinary activity. Indeed, such were the haste and the severity of their proceedings that a great reaction took place in public opinion; and the Spanish bishops sent a remonstrance to Rome. The two inquisitors were deprived of their charge; a papal brief censured the cruelty and undue haste which they had displayed. An inquisitor-general for all Spain was appointed in the person of Fra Thomas de Torquemada. But the Spanish government, at that moment occupied in conquering from the Moors of Granada the last portion of the national territory held by the Moslem for more than 700 years, was not disposed toward lenient measures. There was great agitation among Jews and Moriscoes. Torquemada established branch tribunals in Cordova, Jaen, and Villa-Real, and displayed inflexible rigour against apostates and feigned Christians. After his death the Holy Office was also established in Toledo. Established amid the exciting circumstances of the time, when the Spanish nation was making its last mighty struggle for perfect national independence, and while Morocco beyond the Straits of Gibraltar was powerful and threatening, it is not surprising that the inquisition should have been popular with the masses. It was directed against two races which for so many centuries had been the combined foes of the national liberty and the national faith. These circumstances explain many things in the Spanish inquisition, without furnishing an excuse for undeniable cruelty. On this point, however, impartial criticism cannot accept the statements or calculations of Llorente, whose list of horrors can only please vulgar prejudice. The best Spanish scholars regard him as unworthy of confidence; the least favourable to the church and the ancient monarchy admit that he greatly exaggerated and guessed at results. The truth about himself is that he was one of those priests who favoured the principles of the French Revolution, and were anxious to throw discredit on the old order of things. To please Godoy and the court he wrote a book against the Basque liberties. He accepted office under King Joseph Bonaparte, and while at the head of the archives of the inquisition at Madrid, conceived the idea of writing a history of that institution which would suit the popular taste in France. Banished from Spain, he executed his design in Paris. He never studied the archives of the inquisition at Seville. His work, as he expected, was a good pecuniary speculation. He followed it up by translating into Spanish the novel of "Faublas," one of the most licentious that ever disgraced French literature, and one of the many vile French works then systematically imported into Spain. His statement that, during its existence of 330 years, the Spanish inquisition had condemned to death some 32,000 persons, and sentenced 291,000 to various penalties, is, as he confesses, an approximate estimate. But it is a very wide approximation. We must wait for the work of Guichot, written from the original documents and on the spot, to form a correct judgment. Even then we must be prepared for a larger list of victims than humanity or religion would now attempt to excuse. The most terrible epoch in the reign of this dread tribunal in Spain needs only to be compared with a like period in Great Britain and Ireland, from 1560 to 1660, when, in Ireland particularly, more persons perished through the deplorable workings of national and religious animosity, and the pitiless proceedings of "inquisitions" equally odious, than were destroyed by European wars for the last hundred years. The Holy Office in Spain was, in fact, independent of the popes. The highest ecclesiastical dignitaries in the kingdom were tried and punished by it in spite of energetic remonstrances from Rome. The kings found it politic to say that the grand inquisitor's power

was greater than that of the throne. They made the tribunal take cognizance of many other crimes and offences besides those of heresy or apostasy. Polygamy, seduction, unnatural lust, forgery, coining and passing false money, imposture, personation, and even smuggling, were subjected to its jurisdiction, as well as sorcery, magic, witchcraft, and astrology. Thus the list of the accused and condemned was enormously swelled. Again, the *autos da fé* were public judicial ceremonies, in which persons tried for heresy and *not* condemned to death appeared before the multitude, abjured heresy, and recited aloud the creed. The *auto* was an act of solemn reconciliation with the church. Mohler, in his church history, affirms that the *autos* "were as a rule bloodless. But few inquisitorial proceedings terminated in the death of the accused." The popular literature of this and the last century invariably represents the hundreds of persons condemned to make an *auto da fé* as destined to be burned alive. The Spanish inquisition was abolished in 1813 by Napoleon; spasmodic attempts were afterwards made to revive it by Ferdinand VII.; but it was finally extinguished in 1835. In Portugal the inquisition never assumed the severe character it had in Spain, though during the brief Spanish domination it became more of an instrument of state policy.

INSAN'ITY. The term insanity has been applied to all the forms of mental disorder. It is not possible to define it with precision. Nor can any good result follow from refining on the differences which it is said exist between lunacy, insanity, and unsoundness of mind. The legal significations attached to these terms have given rise to much confusion. Any division of insanity must of necessity be more or less artificial, but by common consent medical jurists describe five different forms—mania, monomania, dementia, amentia or idiocy, and moral insanity. The last of these, however, is not recognized by the law.

Mania is a general insanity, marked by mental excitement, and by delusion on all kinds of subjects. There are varying degrees of the affection, depending on constitutional peculiarities. The attack is often preceded by premonitory symptoms, such as uneasiness in the head with confusion of ideas, or uneasy sensations in the stomach. Then succeed mental agitation, sleeplessness, and paroxysms of fury alternating with calms. The sensations are frequently deranged; the appetite lost, depraved, or voracious. The abatement of the disease is evidenced by the disappearance of the hallucinations under which the patient laboured. The result of a case will depend on whether it has its origin in organic disease of the brain, or merely in functional derangement.

Monomania is characterized by the predominance of one morbid idea or a limited class of ideas, and there are great varieties in the nature of these. Sometimes there is excessive pride: the monomaniac fancies himself a god or king, possessed of boundless wealth, and having the power to scatter gifts and honours. The morbid desire to kill is one form, the fear of damnation another; and so terrible are the suffering and remorse, that the impulse to commit suicide becomes irresistible. A curious fact among this class of the insane is, that they are often unusually acute on subjects apart from their own delusions, and can reason with subtlety and ingenuity.

In *dementia* we have a rapid succession of ideas without connection. The patient expresses himself with untiring volubility, and passes from one subject to another. He is at one moment kind and gentle, at another furious and angry. He will for hours together repeat the same sentence or word. The reasoning and judgment are lost.

Amentia or *idiocy* is either congenital or accidental. The most remarkable instance of the first of these is to be found in the cretins of the Valais, with whom it is associated with bodily ailments and malformations. Idiocy may arise accidentally from injuries of the head, the effects of violent emotions, or organic diseases of the brain. Idiots as a rule speak little, and amentia constitutes the most hopeless form of insanity.

In *moral insanity* there is disorder or loss of moral principle without any delusion. There are a great many varieties and degrees of this. In some there is the irresistible desire or impulse to commit theft; in others to drink to excess; in others to acts of incendiarism. In fact, moral insanity is closely allied to crime, and it is exceedingly difficult to draw the line of demarcation between the two. The most fruitful source of this affection is a neglected or injurious education.

There are in insanity various changes in the state of the mental powers. Sensation and perception are often deranged. Morbid states of the former are insensibility to cold and fatigue; of the latter, the seeing of what does not actually exist. The attention and memory are also affected, especially in dementia, while imagination and the association of ideas, which are suspended in amentia, may be exuberantly active in the other forms of mental disorder. Derangements of reasoning and judgment occur in insanity, but often the conclusions of maniacs are very logically deduced, if the premises be granted; at other times we find the reasoning erroneous, as well as the judgment founded on it. Sometimes both faculties are suspended or annihilated in insanity. The change, however, which occurs in the moral faculty is the cause why the insane are not considered as responsible agents, and the rapidity with which this change occurs when insanity has manifested itself is sometimes very rapid, persons of the most correct and virtuous habits suddenly becoming vicious in the extreme.

The causes of insanity are numerous, some of them easily traceable and others obscure. The hereditary predisposition is often very well marked, and may depend on faulty structure of the brain. Persons of a melancholy temperament, and who suffer from disorder of the digestive functions, are predisposed to the disease, and the tendency in such is greatly increased by fanatical views of religious matters. Further, insanity follows on indulgence in vice or debauchery, may be produced by exciting passions or violent mental exertions, by the state of pregnancy, and other physical conditions of the system. But perhaps intemperance is in this country the most frequent exciting cause.

The signs of approaching insanity vary greatly, but the first symptom usually noticed is an alteration in the *emotional* condition of the patient. The alteration may take the form of dulness, apathy, persistent gloom and depression of spirits, or the opposite characteristics of restlessness, irritability, hilarity, and excitement. This may be accompanied or followed by a change in the ordinary character and disposition of the patient in relation to matters of family, social, or business life, an alteration which becomes more marked in its manifestations as the disease progresses. There is often at the same time a good deal of general physical uneasiness, a feeling of fulness in the head, headache, and insomnia. The latter is one of the commonest signs of approaching insanity, almost every variety of which is ushered in by sleeplessness, sleep either being deficient and disturbed or absent altogether. Many of the symptoms enumerated may arise from causes altogether apart from insanity, but where there is any reason to fear they arise from a disordered state of the brain, skilled advice should be secured as soon as possible, for mental disease is always most susceptible to treatment when dealt with in its early stages.

The treatment of the insane is now conducted upon the most humane and philosophic principles. All experience goes to prove the desirability, nay necessity, of seclusion, and many of the objections which formerly existed against lunatic asylums have been removed. In a well-regulated establishment restraint is very seldom resorted to, and

every means are used to employ and gratify the inmates. The moral treatment is of more efficiency than the medical, and hence it is that the heads of lunatic asylums require to be men of mental vigour and capacity.

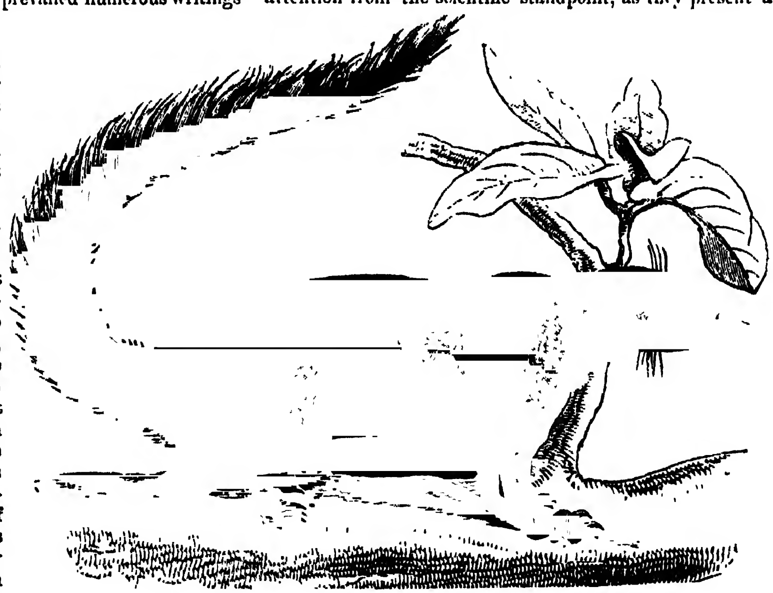
It is beyond our province in this mere sketch of the subject to dwell upon the numerous and weighty points which occur in medical jurisprudence relative to insanity. These have principally reference to the responsibility of criminals, and are attended often with great difficulty, and cause no little perplexity. The true difficulty lies in determining where eccentricity ends and insanity begins, and we cannot hope to lay down general rules which will apply to every individual case. Then there are instances in which the succession to property is disputed on the ground of mental incapacity of the testator. In the records of the law many curious cases will be found, and all the great English lawyers have endeavoured, but fruitlessly, to lay down a test by which insanity can be tried.

It only remains to add, that of late years there seems good reason to believe that, owing partially to the excitement of life, the wear and tear of business, the hurry of railway travelling, and such like causes, insanity is increasing; and as these will in all likelihood be augmented and aggravated with the progress of the times, the increase of this disease must be looked upon as one of the penalties we have to pay for our advancing civilization. The laws relating to the insane are fully explained in the article LUNACY, and statistics, mode of treatment, &c., in LUNATIC ASYLUMS.

INSCRIP'TIONS, the name given to all writings engraved on such durable materials as stones, metals, gems, &c. The use of such materials for preserving a record of public events seems to have preceded by a long period the use of perishable substances, such as skins, parchment, or paper, and notwithstanding the use of the latter they have never ceased to be employed from the earliest times up to the present. Hence there have been found in all parts of the world where civilization has prevailed numerous writings of this kind, many of which from their nature and great antiquity are of the highest value to the student of history or philology. Among the first of such records to attract the serious attention of European scholars were the inscriptions of ancient Greece and Rome, many of which were copied and studied in the revival of learning during the sixteenth century. In more recent periods numerous other inscriptions were brought to light by travellers in Egypt, Syria, and other parts of the East, but it was not until the commencement of the present century that they received much attention. The value of the immense number of inscriptions known to exist on the monuments and temple walls of Egypt was perceived, but as the language in which they were written had long been dead and utterly forgotten they were regarded as being beyond translation. The discovery of the famous Rosetta stone in 1799, with its trilingual inscription, however, afforded a key to the translation of some of the characters used, and this discovery gave an impulse to the study of inscriptions that was simply invaluable. During the present century the investigation of inscriptions has been followed with great zeal and ardour by the scholars of England, France, and Germany, and their researches have extended into all parts of the world. Some hundreds of thousands of inscriptions have been copied and published, and the greater part, though written in extinct languages, such as Egyptian, Zend, Accadian, Pali, &c., have been compelled to reveal their secrets by the patient investigation and comparison to which they have been subjected. There are, however, some, like the celebrated inscriptions of Etruria, which up to the present remain undecipherable; but judging from the success that has attended the labours of the past generation and the rapid growth of the science of comparative philology, there is every reason to expect that everything of value will be recovered in due time.

Of the inscriptions that have been collected there are some which date from a remote antiquity. The oldest known are those of ancient Egypt, some of which are assigned to about 3000 B.C., or 500 years earlier than the oldest papyri known to be in existence. The next in antiquity are those of Assyria, and some engraved bricks and cylinders have been recovered from Babylonia which date from a period more than 2000 years before Christ. According to some students there are inscriptions in China which date from the year 2278 B.C., but others assign the period about 1200 B.C. for the earliest known in that country. Some Phœnician inscriptions have been found in Syria which date from the ninth century before Christ, the most important being the celebrated Moabite stone, erected by Mesha, king of Moab, to celebrate his victory over the Israelites. See also EGYPT, ETRURIA, HIEROGLYPHICS, CUNEIFORM CHARACTERS, &c.

INSECTIV'ORA is an order of MAMMALIA. The Insectivora form a small group containing animals of small size and of retiring habits, neither prized as domestic pets when alive nor furnishing, when dead, anything of much commercial value. This order, however, deserves great attention from the scientific standpoint, as they present a low, primitive, generalized type of structure. The Insectivora live on the ground or burrow below it; a few are aquatic or subaquatic. The Bangsrings (Tupaiidæ) are arboreal and feed on fruits as well as on insects. From the tentative, transitional nature of this order no one



Bangsring.

character is constant throughout; the following characters are of general application, the more aberrant genera being noticed further on. The limbs are generally short and feeble, constructed for walking or digging; the feet are generally provided with five toes, which are furnished with claws, and are plantigrade, that is to say, the whole sole is applied to the ground in walking; clavicles are present, except in the River Shrew (Potamogale). A remarkable uniformity pervades the whole dental series, rendering it often difficult to trace readily the division into incisors, canines, molars, and premolars. The typical dentition is shown in Gymnura, where the dental formula is—

$$I.\ \frac{3-3}{3-3};\quad \frac{1-1}{1-1}\quad pm.\ \frac{4-4}{4-4}\quad m.\ \frac{3-3}{3-3} = 44.$$

The incisors are short and simple, and the canines are small; the molars have well-developed roots, and their crowns studded with small tubercles. The mammæ are generally situated on the abdomen. A low degree of intelligence is indicated by the smallness of the brain-case and the absence of convolutions on the cerebral hemispheres.

This order is usually divided into ten families: Galeopithecidæ, Tupaiidæ, Macroscelidæ, Erinaceidæ, Centetidæ, Solenodontidæ, Potamogalidæ, Chrysochloridæ, Talpidæ, and Soricidæ. The first of these contains only one genus, GALEOPITHECUS, the so-called flying lemur (see Plate, fig. 4). This genus is so aberrant that it forms in most systems of classification a distinct suborder, Dermoptera; it has a broad expansion of the integument, extending from the neck to the tail, and acting as a parachute. The BANGSRINGS (see cut) represent a high development among the Insectivora; they are arboreal and feed partly on fruit. The ELEPHANT SHREWS (Macroscelidæ) have a long proboscis-like snout, and the metatarsal bones are very long; they are terrestrial and progress by leaping. The Erinaceidæ includes the HEDGEHOG (Plate, fig. 1) and the BULAU (Gymnura). The TENRECS (Centetidæ), peculiar to Madagascar, are among the largest Insectivores. The Solenodontidæ contain only one genus, SOLENODON, from Hayti and Cuba: the dentition is peculiar and the mammæ are very far back on the groin. The Potamogalidæ contain only one species, the RIVER SHREW; clavicles are absent, and other peculiarities occur sufficient to justify the erection of a distinct family for this animal. The GOLDEN MOLES (Chrysochloridæ) are more nearly allied to the Tenrecs than to the Common MOLE (Plate, fig. 2), which forms the type of the next family, Talpidæ, in which the whole structure is modified by the subterranean fossorial habits. The SHREWS (Soricidæ) include more than half the known number of the Insectivora. They are small mouse-like animals (see Plate, fig. 3), living generally on land, but taking to the water in some cases.

The Insectivora are found throughout the temperate and tropical regions of the world, except South America and Australia. Fossil Insectivora have been found in beds of the Eocene period; some of the existing genera (Sorex, Myogale) date from the Miocene.

INSECTIV'OROUS PLANTS belong to various natural orders in the vegetable kingdom. They should more strictly be termed carnivorous plants, as their prey is by no means confined to insects. The best known is the Common Sundew (*Drosera rotundifolia*). It grows in wet marshy places in the British Isles. The leaves spread from the roots like a rosette, with the flower-stalks in the centre. The blade of the leaf is round, covered on its upper surface with hairs or tentacles, of which there are about 200, each tipped with a gland. The gland is surrounded with a transparent secretion, which glitters in the sun like a drop of dew, whence the common name for the plant and the scientific name of the genus (Drosera, from Gr. *drosos*, dew). The beauty of the dew-drop is considerably increased by a purplish fluid contained in a layer of cells below the epidermal surface. Insects are attracted by the pink glitter of the leaves, but when they settle they stick fast in the viscid fluid of the glandular drops. Every movement helps to insure their destruction, for the tentacles are sensitive, and begin to move towards the centre of the leaf, bearing their prey with them. Shortly the movement is communicated to the surrounding tentacles, which also close in upon the insect and soon drown it in their secretion. The bending of the tentacles is excited (1) by repeated touches, though unaffected by rain-drops; (2) by the contact of a solid particle, even when this is so minute as to weigh only $\frac{1}{78740}$ of a grain; or (3) by the absorption of an infinitesimal quantity of a nitrogenous fluid. The nitrogenous material of the insect is dissolved and then absorbed by the leaves. This digestion is the same in kind as that which takes place in an animal stomach, for a ferment and an acid are both present, the acid appearing in the secretion during the bending of the tentacles.

Venus's Fly-trap (*Dionæa muscipula*), a native of Carolina, was first described by Ellis in 1768 in a letter to Linnæus; but this celebrated botanist had no opportunity of studying it, and, although he declared it to be *miraculum naturæ*, he supposed that it was only by accident that insects were caught. The leaves all spring from the ground. The leaf-stalk has broad leafy extensions on each side. The blade of the leaf hinges on the midrib, so that its two lobes can shut up, just as a book may be closed. The margins of the lobes are bordered with spines, which interlace on closing. The sensitiveness lies in three stiff hairs arranged in a triangle on each lobe, and hinging at their base. When one of these is touched the leaf at once shuts up, securing the insect if it is large enough to be worth digesting, but if it is small enough it escapes through the interlocking spines. The surface of the leaf is quite dry, but in the neighbourhood of the sensitive hairs there are several glands. When these have absorbed a minute quantity of nitrogenous matter from the crushed insect, they pour out an acid fluid containing a ferment which speedily digests the food, and then reabsorbs it in the soluble condition. One meal is as much as most leaves are capable of managing in their lifetime. Burdon-Sanderson has shown the existence of an electric current in the leaf, and also that there is a negative variation of the current when the leaf closes. This is due to the conversion of electro-motive force into mechanical work, and is of very great importance as showing the resemblance between the closing of the leaf and the contraction of a muscle.

Aldrovanda vesiculosa is a "miniature aquatic Dionæa." It is a native of Europe, and varieties are found in India and Australia. It has no roots, and floats about on the surface of the water. The leaves are arranged in whorls round the stem. Each leaf-blade, as in Dionæa, has two lobes; but they open only as much as a living mussel-shell, and therefore even less than in Dionæa. A narrow rim of each lobe is turned inwards, so that their outer surfaces come into contact when the leaf closes. A portion of the inner surface of the leaf next the midrib is studded with glands and sensitive hairs; the larger portion next the infolded rim bears four-lobed projections, which are considered to be for the purpose of absorbing the soluble matter already digested by the glands.

The Portuguese Fly-catcher (*Drosophyllum lusitanicum*), also found in Morocco, has linear leaves several inches in length, covered with stalked glands, shaped like minute mushrooms. These correspond to the tentacles of the sundew, except that they are not sensitive, and the secretion is watery, and also acid before being touched. An insect does not stick to them, but crawls onwards, getting its wings wetter, until at last it sinks down on the surface of the leaf, which is covered with small glands.

Butterwort (Pinguicula) is abundant in north temperate regions, and passes down the Andes to Patagonia. *Pinguicula vulgaris* is common in bogs in the British Isles. The leaves are radical, fleshy, oval in shape, with incurved margins. They bear two sets of glands, some stalked and others almost sessile. The surface is covered with a viscous secretion, which increases and becomes acid when the glands are excited by nitrogenous matter. The leaves digest not only insects, but pollen seeds and small leaves of other plants which have fallen upon them.

Bladder-wort (Utricularia) numbers no less than 150 species, many of which are found growing in water in most parts of the world. The leaves are submerged, and are finely divided; they bear minute bladders fitted with a transparent valve, which entrap water-insects, small crustacea, and even the fry of fish. They appear to have no digestive glands, but are provided with four-lobed projections, which absorb the animal matter when decomposed. The remarkable PITCHER-PLANTS are also insectivorous, but will be considered with more advantage in a separate article.

INSECTS (Insecta or Hexapoda), one of the classes of ARTHROPODA. Insecta is synonymous with Aristotle's term Entoma, denoting animals in which the body was cut into and divided into numerous segments. Formerly the term included Crustacea, Arachnida, Myriapoda, and Insecta (in the modern significance), and was thus co-extensive with the modern term Arthropoda. As now used the term Insecta refers to the more or less conspicuous division of the body into three parts, head, thorax, and abdomen; the term Hexapoda, which is preferred by some, refers to the three pairs of walking legs with which the members of this class are always furnished. Insects are in general covered with a horny or coriaceous integument, serving as an external skeleton; they possess, when mature, three pairs of legs; they are capable, for the most part, of flight, having two or four wings. The sexes are distinct, the females being, as a rule, oviparous; they undergo metamorphosis before arriving at maturity. Circulation is effected by a pulsating dorsal vessel provided with numerous valves, and respiration by fine tubes (*tracheæ*) which ramify through the body.

Insects fly, walk, leap, swim, dive, mine into the earth, bore into wood, build structures which fill our minds with astonishment, and in various ways exhibit the possession of marvellous instinctive faculties, insomuch that many of their proceedings appear to be the result of profound reasoning. They furnish us with silk, wax, honey, lac, cochineal, and gall-nuts. Some are eaten by various tribes of men, and they furnish food to mammalia, birds, reptiles, and fishes, and to the carnivorous of their own class. Some are remarkable for beauty, for splendour of colouring, for gracefulness and delicacy; others surprise us by the strange singularity of their forms, and others again by their natural lantern, which gleams brilliantly in the hours of darkness.

If we place an insect before us, we shall find that it is divided into three distinct parts: the head, the thorax, and the abdomen. Each of these parts is made up of segments. In the abdomen only eight or nine segments are, as a general rule, recognizable externally; sometimes the number is still further reduced owing to the posterior segments being telescoped. The full number, eleven segments, can be traced in the abdomen of the embryonic insect. Again, the head appears to be a solid horny case, but the existence of several paired organs of the mouth homologous with those of a crustacean demonstrates that this part is built up of several segments. The thorax is composed of three segments, which are generally very distinct externally.

The head bears two important sense-organs, the antennæ and the eyes. The antennæ are long jointed processes placed on either side of the anterior portion of the head. They are probably to be regarded as the homologues of the prostomial tentacles of the chætopod worms, and not as modified appendages, as are the antennæ of crustaceans. The various forms which these organs may assume are shown in the Plate INSECTS, figs. 1–23. Even in the same species there may be a difference in form between the antennæ of the male and that of the female. The antennæ are undoubtedly important organs of sense, but their special function is not clear. Every known sense, save that of sight, has been in turn ascribed to them. In many cases they are certainly tactile organs, while they appear to be the media through which insects that display a high degree of intelligence, such as ants, convey information to one another. The eyes are of two kinds, simple and compound. The simple eyes (*ocelli* or *stemmata*) are usually three in number, arranged in a triangle on the vertex, and each provided with a separate nerve. The compound eyes are always two in number, each being sometimes apparently divided; they are very large, and situated on the sides of the head. Each compound eye consists of a great number of hexagonal facets, each of which is the surface of an eyelet; the eyelets are long cones separated from each other by layers of pigment, and with their bases communicating with the optic nerve.

The crown of the head is called the vertex; immediately below is the clypeus, which is followed by the labrum or upper lip. The organs of the mouth (see Plate) are variously modified for biting, sucking, pricking, &c. The biting or mandibulate mouth may be considered the most primitive. There are three pairs of mouth-organs homologous with the gnathites of a crustacean, the mandibles, maxillæ, and the labium or lower lip, formed by the union in the middle line of two appendages. The labrum is usually movable, and articulated to the clypeus; it is opposed to the labium, and their joint use appears to be to keep the food in its proper place while the jaws work upon it. On each side of the labrum are the mandibles, a strong pair of jaws used for seizing and biting; when viewed from above beneath they generally represent a figure more or less approaching to a triangle; they are externally convex, but internally concave, the concave surface being furnished with serrations or tooth-like processes. Below these are the maxillæ, or second pair of jaws. Each maxilla is made up of several jointed pieces, to one of which is articulated a long jointed tactile process, the maxillary palpus. The second pair of maxillæ form, by their union in the middle line, the labium. The basal portion of the labium is the mentum or chin; articulated to this is the ligula, usually bilobed; each of the lobes may divide longitudinally into two divisions, the outer of which is known as the paraglossa. On the outer edge of the labium on each side is a small piece, the palpiger, bearing the labial palpus, which usually consists of three joints. This general arrangement of the mouth-organs obtains throughout the class, but the form of the appendages is greatly modified in accordance with the various habits of insects. In the bees the general character of the mouth is mandibulate, the mandibles being large and powerful, but the ligula becomes an elongated tube sheathed by the maxillæ. In the Lepidoptera (butterflies and moths) the maxillæ form a long tapering tube or proboscis; the labrum and labium are much reduced, but the latter bears a pair of very large palpi. In the Diptera (flies) and Hemiptera (bugs) the sucking or haustellate mouth is fully developed, all the organs taking part in the formation of the suctorial proboscis; the labium in both orders forms the sheath of the tube.

The thorax is composed of three segments, respectively named prothorax, mesothorax, and metathorax. Special names are applied to the upper and lower surfaces of each segment; thus the upper surface of the thorax consists of pronotum, mesonotum, and metanotum, the under surface of prosternum, mesosternum, and metasternum. The segments of the thorax are usually more or less distinct, the

mesothorax being commonly the largest. The mesonotum or upper surface of the mesothorax bears in many cases a small raised plate, the scutellum. The prothorax carries the first pair of legs, the mesothorax the second pair and the first pair of wings, the metathorax supports the third pair of legs and the second pair of wings. Dipterous insects have only two wings, which are furnished at their back with a little scale or alulet, the use of which is not very clear: the hind wings are represented by small hair-like processes, called halteres or poisers.

The legs are always six in number in the true adult insects; they are variously modified for running, leaping, swimming, burrowing, and even for adhesion, by means of suckers, to panes of glass, the ceilings of rooms, &c. (as we see in the common fly). They consist of five principal parts —viz. the coxa, or hip, next to the body; the trochanter; the femur, or thigh; the tibia, or shank; and lastly the tarsus, or foot, never composed of more than five joints, and often ending in two hooked claws, called unguiculi, in addition to suckers.

The wings are expansions of the integument primitively connected with respiration. They consist of two thin membranes, strengthened by firm hollow tubes, called nervures or veins. These nervures are usually regarded as air-tubes or tracheæ: the blood circulates in the wings, following the course of the nervures. In the Beetles (Coleoptera) the anterior pair of wings become converted into horny organs. forming a protective covering for the hind wings, which are alone effective in flight; the fore wings are in this case distinguished by the special name elytra, or wing-cases. The same process takes place more or less in the fore wings of the Orthoptera (cockroaches, &c.) and of the Hemiptera (bugs, &c.) Either pair of wings may become greatly reduced. In some cases the wings are not developed at all in the females or in both sexes.

The abdominal segments are protected both dorsally and ventrally by horny plates. The perfect or mature insects have no abdominal legs. The extremity of the abdomen may bear various appendages connected with the generative apparatus; in addition caudal-jointed processes may be present.

The digestive system is variously modified according to the nature of the food. In its most complete form it consists of an œsophagus, following the mouth, crop, proventriculus or gizzard, stomach, small and large intestines, and rectum, terminating at the anus. Attached to the œsophagus are usually a pair of salivary glands, which are blind tubes, each with a reservoir. The salivary glands are often modified as silk-glands. At the junction of the stomach and intestine are numerous long slender tubes, known as the Malpighian tubes, which have probably an excretory function. The spaces between the coils of the alimentary tract and the other organs are occupied by a peculiar fatty substance, the adipose body.

The nervous system consists essentially of a double cord lying along the ventral floor of the body. The cord meets in front of the mouth in a large bilobed mass, the brain or cerebral ganglion supplying the eyes and antennæ with nerves. Immediately below the mouth is the large subœsophageal ganglion, united to the brain by commissures, and sending nerves to the organs of the mouth. The two cords, now more or less united, are continued throughout the body, with ganglia disposed at intervals, normally one in every segment. The thoracic ganglia give off nerves to the wings and legs.

Respiration is effected by means of an immense number of tubes, called tracheæ, which ramify throughout the interior of the body, and run into the wings. The tracheæ are essentially membranous tubes, having their walls strengthened by a spiral chitinous thread, which gives them externally an annulated appearance. In land insects the tracheæ communicate with the exterior by means of lateral apertures, the stigmata, disposed in regular succession along the thoracic and abdominal segments. In many aquatic insects, especially in the immature condition, we find special gill-like organs, expansions of the integument in form of threads and plates, which absorb air from the water and convey it to the tracheæ. Some aquatic larvæ are provided at one extremity of the body with a fine tube, which can be protruded to the surface of the water.

The circulatory system of insects is very simple. There is a long dorsal vessel or heart, composed of a series of chambers communicating with each other by means of valves lying just beneath the integument of the abdominal segments, terminating in a simple vessel (cephalic aorta) running through the thorax to the head; thence the blood, which is a colourless granular fluid, escapes into the interspaces of the body, and finally enter the dorsal vessel again from behind.

All true insects undergo a metamorphosis in the passage from the egg to maturity. The metamorphosis may either be complete, in which case the insect is said to be metabolic, or incomplete, when it is ametabolic. When the metamorphosis is complete the larva (caterpillar, maggot, or grub), after several moults, changes into a pupa, which is generally inactive, and takes no food. In ametabolic insects there is no true pupa state, the larva going on moulting and gradually increasing in resemblance to the mature insect. The larvæ of many insects, as the gnat, the dragon-fly, &c., are aquatic in their habits, but furnished with an apparatus which enables them to respire air. Some weave cocoons of silk, some bury themselves in the earth, and some suspend themselves in order to pass through the pupa state. The legs of larvæ or caterpillars are divided into two series—viz., the true or persistent, and the prolegs, which are temporary. The true legs consist of three pairs attached respectively to the first three segments of the body, which constitute the future thorax. The prolegs are soft, short, and conical; they vary in number in different species.

Viviparous generation occurs occasionally in insects, notably in the Flesh-fly (Sarcophaga) and the Aphidæ or plant-lice. Parthenogenesis or virgin reproduction occurs chiefly in the Hymenoptera and Hemiptera. In the social communities of the Hymenoptera and Termites, neuters or undeveloped females are found in addition to males and females.

The best system of classification of insects is a matter of dispute. The classification generally adopted is a combination (with modifications) of three distinct systems: the alary, based on the number and character of the wings; the cibarian, based on the character of the mouth, whether formed for biting or sucking; and the metamorphotic. Insects may be divided into the following orders (which are treated in detail in separate articles):—HYMENOPTERA, Coleoptera (BEETLES), DIPTERA, LEPIDOPTERA, NEUROPTERA, ORTHOPTERA, HEMIPTERA, THYSANURA, the last group being very aberrant, and considered by some to be outside the pale of true insects.

Fossil Insects.—The number of fossil insects, whether we estimate individuals or species, is very small compared to the probable number of anciently existing races—a circumstance quite explicable by reference to the phenomena which are now taking place in nature; for there is reason to believe that but a very minute proportion is buried and preserved in lacustrine, estuarine, or marine deposits now in progress. No doubt vast numbers of insects pass from the shore and fall into the sea, as we learn from the first voyage of Cook, who sailed through myriads of insects, some on the wing and others in the water, even 30 leagues from land, off the coast of South America; but few of these escape the watchful finny races, or ever reach the bottom of the sea. In like manner we find land insects heaped in profusion by winds on certain tracts of fresh

water, and borne down the course of rivers by inundations; and these cases, by the aid of particular suppositions, such as evaporation or slow draining off of the water, may offer the nearest analogy to the facts actually observed in the greater number of insect deposits.

Insect life commences early in the Palæozoic epoch. In 1884, in the Silurian sandstone of Calvados, a fossil insect-wing was discovered, agreeing in character with the wings of a cockroach (Blatta), which belongs to the order Orthoptera. The remains of insects referred to the order Neuroptera have been discovered in the Devonian series. In the Carboniferous rocks fossil insects are more abundant, the orders Neuroptera, Orthoptera, and Coleoptera being represented. In the Jurassic rocks the Hymenoptera and Hemiptera make their first appearance. The Diptera and Lepidoptera are first known from the Tertiary strata. An immense number of insects belonging to species now extinct have been entombed in the fossil resin known as amber.

INSESSO'RES. See PASSERES.

INSOL'VENCY. See BANKRUPT.

INSPIRA'TION (literally, breathing into) is a word used once in the New Testament (2 Tim. iii. 16) in reference to the sacred writings, and generally used in theology to denote the divine origin and authority ascribed to the books of the Bible. A distinction is drawn between *inspiration* and *revelation*, the former being claimed for the whole of Scripture, the latter being limited to such discoveries of spiritual truth as being previously unknown, and unattainable by the unassisted human faculties, were made known by the special influence of the Holy Spirit upon the minds of the writers.

During the early ages of Christianity there seem to have been considerable divergences of opinion concerning the number and authority of the sacred books and their position in the church, but the fact of the existence of a series of specially inspired and authoritative books was always admitted. The history of the way in which the canon was completed has already been described in this work [see BIBLE], and since this was accomplished all orthodox theologians have agreed in ascribing a special divine character to the Jewish and Christian scriptures, or the books of the Old and New Testaments. At the same time this belief was for a long period rather practical than speculative, and the doctrine of inspiration was not formally defined or carefully examined until the time of the Reformation. Against the authority of the infallible church the reformers advanced the authority of an infallible book, and though individuals among them, notably Luther himself, allowed considerable liberty of judgment, the tendency of the Protestant teaching was to advance and magnify the authority of the Bible. Hence came the necessity for a closer examination of the subject, and different theories of inspiration were propounded by theologians and scholars. No single theory, however, ever succeeded in gaining general assent, and the controversy thus commenced has continued down to the present day, gathering strength as it has proceeded, until now its results seem likely to affect most profoundly the future development of Christianity. To give any lengthened account of this controversy, or to decide in favour of any particular theory, would be foreign to the scope and character of this work, and a brief notice of the principal theories is all that will be attempted.

The most extreme of these, but one which has found numerous advocates, is that of *verbal* inspiration. By the advocates of this theory it is claimed that the Holy Spirit dictated the sacred books, word for word, in the first instance, the author being under such an influence as suspended all voluntary action, or as one defender of this view expressed it, "Every word, syllable, and letter of the Bible is the direct utterance of the Most High." The arguments in favour of this theory are generally based upon the supposed necessities of the case, and it has been urged that a revelation of divine truth must of necessity be pure, for any mingling of human thought destroys its authority; that in giving a revelation of his will to man the words by which it was to be made known must have been given also, for we cannot suppose that God, having given a revelation, would permit it to be spoiled by unsuitable expression. Again, we usually think in words, and a revelation given to human thought must have been given in the form of words. Lastly, the advocates of this theory have inquired, "If the revelation be not all of God, who is to distinguish between what is human and what is divine?"

The orthodox opponents of this theory have been generally content to appeal to the Bible itself in order to show that it is only in very few instances that the writers of the books of the Bible claim to have received a verbal message from the Spirit of God; that the structure, style, and history of most of the sacred writings are alike opposed to this theory; and that the writers of the books of the New Testament in their quotations from the books of the Old Testament pay little or no regard to the exact letter, often using the Septuagint version in preference to the original Hebrew, and in at least half of these quotations they disregard the exact words of either version. It is further urged that it would be as reasonable to claim a supernatural care for the sacred words as for their gift in the first instance, whereas it is beyond question that the various readings in the manuscripts upon which we depend for the text are numbered by tens of thousands. The theory of verbal inspiration has been defended by some eminent divines in the past, but it is now abandoned by nearly all competent scholars. A modified form of this theory, however, in which different degrees of inspiration are distinguished, has been very widely accepted by Protestant theologians. Thus verbal inspiration has been claimed for such truths as were given directly by the Holy Spirit, and were not previously known to the recipients; a lesser degree of inspiration, but sufficient to prevent them from falling into any errors for the expression of doctrines or facts with which they were previously acquainted; and a third degree, which guided them in making use of the materials of others. This theory allows for the evident differences of style which exist in the different writings, and for the fact that most of the historical books are compilations rather than original works, but it claims absolute truth for the whole collection. Until a comparatively recent period this theory in all its essential parts was tacitly accepted by nearly all the Protestant churches, and it may still be regarded as representing the general opinion on the subject. From the time of the Reformation, however, up to the present, there have always been some Protestant teachers who have maintained that while the fundamental truths of the Bible were given by inspiration, the arguments, illustrations, the choice of language, &c., were purely human, and, moreover, that inspiration could be claimed for a portion only of the material of the books. The progress made in scriptural and historical criticism during the present generation has tended to bring this view of the Bible ever more and more to the front, and its influence is now seen even in the works of the most orthodox and devout of Christian scholars. In a published letter of Dr. Samuel Davidson, written in 1884, he says upon this subject, "As to the plenary—a term all but identical with verbal—inspiration it cannot be maintained. Inspiration properly belongs to persons, not books. The authors of the different works contained in the collection of the Bible—of most of whom we know little or nothing, sometimes not even the name—were men of various intelligence and endowments. Possessing unequal gifts, their productions are of unequal value. As infallibility belongs to God alone, none of them was infallible in what he said or wrote. Each wrote according to his light and the purpose he had in view. Contradictions, inconsistencies,

errors both intellectual and moral, are observable in their writings. . . . There is no warrant in the Bible itself for calling it the 'the word of God.' The word of God is in the Bible, but the Bible is not the word of God. And as the word of God comes through human instruments, it cannot be perfectly pure. Its purity is conditioned and modified by the earthen vessels it is lodged in." A similar view of the matter has received influential advocacy in the evangelical churches of France, and it represents the opinion of the majority of the modern Biblical critics of Germany.

INSTAL'MENT, a specified partial payment of a sum of money. Properly instalment means installation, that is, the being inducted to some post of dignity, honour, or influence. But since candidates for a board of directors, or for simple admission to a company or partnership, would of course be expected to pay some part of their qualification in the concern upon their instalment, the word became limited to this prime condition as its only meaning, and thus split off grammatically from its former synonym, installation. From the original meaning of entrance-qualification the meaning soon extended to other partial payments, and paying by instalments is now a recognized and extremely useful business term.

IN'STINCT is a term which is scarcely capable of strict definition. "An action which we ourselves require experience to enable us to perform, when performed by an animal, more especially by a very young one, without experience, and when performed by many individuals in the same way, without their knowing for what purpose it is performed, is usually said to be instinctive. . . . A little dose of judgment or reason, as Pierre Huber expresses it, often comes into play, even with animals low in the scale of nature" (Darwin, "Origin of Species"). The definition given by Mr. Romanes ("Mental Evolution in Animals") is most satisfactory for practical purposes. Instinct is by him defined as "reflex action into which there is imported the element of consciousness. The term is therefore a generic one, comprising all those faculties of mind which are concerned in conscious and adaptive action, antecedent to individual experience, without necessary knowledge of the relation between means employed and ends attained, but similarly performed under similar and frequently recurring circumstances by all the individuals of the same species." By this definition instinct is as sharply as possible distinguished from reflex action on the one hand and reason on the other. It differs from reflex action in containing the element of mind. Sneezing, coughing, &c., are simply reflex actions, demanding the special co-operation of nerves and muscles without involving any mental processes. Reason, on the other hand, is the power of perceiving analogies, and is concerned in intentional adaptation of means to ends; it is exercised in circumstances which may never before have occurred in the experience of the individual.

Instincts vary greatly in degree. The perfection of instinct is undoubtedly displayed in the actions of the young of higher animals performed at a time when no teaching by the parents could have come into play. Mr. Douglas Spalding showed by various experiments with what a heritage of ancestral knowledge a chicken or a young mammal comes into the world. (Mr. Spalding's experiments are detailed in a paper read before the British Association at the Brighton meeting in 1872, and subsequently published in *Macmillan's Magazine* for February, 1873.) A kitten when it sees a mouse for the first time will show unmistakably its instinctive recognition of its peculiar prey. Chickens will peck at insects, scrape in search of food, and recognize their hereditary foes without any instruction from their mother. The idea that young birds require to be taught to fly is a very general one. Mr. Spalding demonstrated its falsity by keeping young sparrows caged till they were fledged, and then allowing them to escape. It is, however, true that the parent birds usually encourage their nestlings to essay flight. The wonderful perfection of the instincts of insects is well known; the social economies of the bees and ants are the result of instincts brought to extraordinary perfection and tempered with Huber's "little dose of reason." An insect which undergoes complete metamorphosis displays in the course of its life-history the most varied complex instincts. "The difference," says Romanes, "between its previous life as a larva and its new life as an imago, is as great as the difference between the lives of two animals belonging to two different subkingdoms; and the complete adaptation which all the new classes of instincts exhibit to the requirements of this new life is quite as remarkable as the adaptation of the new structures to the same requirements."

Numerous instances of imperfect or mistaken instinct could be given. The Flesh-fly (*Sarcophaga carnaria*) deposits its eggs in the flowers of the Carrion plant (*Stapelia hirsuta*), deceived by the smell, which resembles that of putrid meat. Wasps and bees have been known to visit the representations of flowers on wall-papers in search of honey; a bee has been known to mistake a sea-anemone for a flower; and a similar mistake is recorded of a humming-bird moth visiting the artificial flowers in a lady's bonnet. Though the instinct of nest-building is usually very perfect in birds, mistakes are not uncommon in the selection of sites and materials. The explanation of many cases of this kind seems to be that any change, even the slightest, in the normal course of an animal's life is sufficient to lead the instinct astray. Some ducklings, which Mr. Spalding kept away from the water for several days after they were hatched, showed as much dislike to it as chickens would have done. Imperfection of instinct may also arise from the instinct being in a transitional state and not completely developed. Mr. Spalding made a number of experiments to see if chickens had an instinctive fear of bees, and found that in many cases the instinct only amounted to a shy, suspicious feeling.

The question of the origin and development of instincts is one of extreme interest. The conception of instinct as "lapsed intelligence" was held by G. H. Lewes. According to this theory actions, at first consciously performed, may, as the result of long continuance in successive generations, aided by the principle of inheritance, become instinctive. Instinct therefore has arisen in all cases subsequently to intelligence. Herbert Spencer on the other hand views instinct as differing only in complexity from reflex action, growing out of it, and only involving consciousness in its higher stages. The opinion of Darwin on this question will be seen in the following quotation from the "Origin of Species:"—"It will be universally admitted that instincts are as important as corporeal structures for the welfare of each species, under its present conditions of life. Under changed conditions of life it is at least possible that slight modifications of instinct might be profitable to a species; and if it can be shown that instincts do vary ever so little, then I can see no difficulty in natural selection preserving and continually accumulating variations of instinct to any extent that was profitable. It is thus, as I believe, that all the most complex and wonderful instincts have originated. As modifications of corporeal structure arise from, and are increased by, use or habit, and are diminished or lost by disuse, so I do not doubt it has been with instincts. But I believe that the effects of habit are in many cases of subordinate importance to the effects of the natural selection of what may be called spontaneous variations of instincts—that is, of variations produced by the same unknown causes which produce slight deviations of bodily structure." Mr. Romanes, following out the views of Darwin, distinguishes two principles, to either of which, or to both working in unison, he ascribes the origin and development of instincts. The first principle, to which he gives the pre-eminence, is that

of variation and natural selection; the second is lapsing of intelligence.

In support of the view that variation and natural selection are prime factors in the origin and development of instincts, Mr. Romanes shows that non-intelligent habits occur in individuals, and may be inherited. Tricks of manner displayed by human beings, as is well known, are constantly transmitted. Such a purposeless habit is that of dogs of certain breeds barking round a carriage. The peculiar habit of the tumbler pigeon, which cannot be supposed to have been acquired purposely, is innate in the breed, though aided by imitation. Such habits may vary; and the variations being inherited, will be "fixed and intensified in beneficial lines by natural selection." In this connection Mr. Romanes quotes the instinct of incubation. "Whether or not this instinct began in habits adapted to the protection of the eggs, it is certain that it cannot have begun with any intelligent reference to hatching them; and it is no less certain that before the instinct attained its present degree of perfection it must have passed through several stages of variation, few if any of which can have been due to intelligent purpose on the part of the birds."

The second principle, that of "lapsing of intelligence," is established by showing that intelligent adjustments, when frequently performed by the individual, become either strictly automatic or require less conscious effort than before; and next that automatic actions and conscious habits may be inherited. The evidence on this head is so strong and well known as scarcely to need illustration. Even the style of handwriting, as Darwin points out, may become a family trait. The habit of domestic dogs turning round several times before lying down is an instinct now useless, but doubtless formed at first consciously when the wild ancestor made its bed in long grass. The habit of begging in dogs has been inherited for generations, till it has become instinctive in some breeds. The same habit has been taught to cats, whose progeny inherited it strictly. The dread of man exhibited by many of the higher animals is certainly instinctive; that it was originally intelligent is shown by the fact that in uninhabited islands birds and other animals show no fear of man and his works. This instinctive wildness may be again lost through disuse, as is proved by the history of many of our domestic animals.

But while the origin of many instincts may be referred to either of these two principles alone, they may combine in the development of others. On the one hand primary instincts, or those due to natural selection, may be put to better uses by intelligence; on the other, secondary instincts, due to lapsed intelligence, may be modified and improved by natural selection. The cell-making instinct of the hive-bee has been shown by Darwin ("Origin of Species") to be due to the action of natural selection. But when novel circumstances arise the bees intelligently adapt their constructive instinct to meet such circumstances. The plasticity of instinct is nowhere better shown than in the effects of domestication. Artificial education and artificial selection by man are as effectual in the formation and modification of instincts as of corporeal structures. Domestic dogs do not attack poultry, sheep, or pigs; and on the other hand, chickens have lost their original instinctive fear of dogs and cats. Domestic instincts, as Darwin calls them, are exemplified in the various breeds of dogs. The special instincts of the pointer, retriever, and sheep-dog have been "acquired through artificial selection and training for the good of man, whereas ordinary instincts are acquired through natural selection and training exclusively for the animal's own good. The young pointer often points without any instruction, imitation, or experience; though, no doubt, as we have also seen sometimes to be the case with true instincts, he often profits by these aids. Moreover, each breed of dogs delights in following his own inborn propensity" (Darwin). To such an extent has human selection and training proceeded that the love of man has become instinctive in the dog.

The existence of trivial or useless instincts is no doubt a stumblingblock to any theory of instinct. It is certain, however, that in many cases the utility of the instinct is liable to be overlooked. Those cases of useless instincts that remain admit, as Mr. Romanes points out, of two explanations. The instinct may have arisen from a purposeless habit or trick becoming hereditary in successive generations; if the habit be merely useless, and not detrimental to the species, its growth into an instinct would not have been prevented by natural selection. Again, useless instincts may have the same bearing on the theory of natural selection of instincts as rudimentary organs on that of natural selection of structures. The instinct of an animal, now useless, may have been of great utility to its ancestors. For a consideration of the migrating instinct of birds the reader is referred to the article MIGRATION.

(Darwin's "Origin of Species," and an "Essay on Instinct," published as an appendix to Romanes' "Mental Evolution;" Romanes' "Animal Intelligence" and "Mental Evolution in Animals," London, 1883.)

INSTITUTE OF FRANCE or **INSTITUT NATIONAL.** The various academies of learning in France having been dispersed during the first storms of the Revolution, a decree of the Republic, dated October, 1795, established a national academy for the promotion of the arts and sciences, called the Institut National. It was at first divided into three classes—viz. physical and mathematical sciences, moral and political sciences, and literature and the fine arts. Each class consisted of a certain number of members residing in Paris, and a number of associates in different parts of France, with a small number of foreign honorary members. Napoleon I., when he was made first consul, reorganized the institute, suppressing the class of moral and political sciences, and forming the four classes of—(1) Physical and mathematical sciences, divided into eleven sections—viz. geometry, mechanics, astronomy, geography and navigation, general physics, chemistry, mineralogy, botany, veterinary surgery, anatomy and zoology, and medicine and surgery. This class consisted of sixty-two resident members, who could appoint 100 correspondents, including foreigners. (2) French language and literature, consisting of forty members, like the old Académie Française. (3) Ancient history and literature, corresponding to the old Académie des Inscriptions et Belles Lettres, and consisting of forty members, eight foreign associates, and sixty correspondents. (4) Fine arts, divided into five sections—painting, sculpture, architecture, engraving, and music. This class consisted of twenty-eight members, eight foreign associates, and thirty-six correspondents, native and foreign. An annual allowance of 1500 francs was fixed for each resident member, and a salary of 6000 francs to each of the perpetual secretaries, of whom there were two for the first class and one for each of the other three. Annual prizes were also awarded. This arrangement continued during the empire, except that the institute took the name of Imperial. After the restoration Louis XVIII., by an ordinance, 21st March, 1816, without changing the arrangements of the departments of each class, restored the old names of Académie des Sciences, Académie Française, Académie des Inscriptions et Belles Lettres, and Académie des Beaux Arts, giving to each a more independent organization, but still keeping them united in one academical body called the Institute. Louis Philippe, by a royal ordinance, 26th October, 1832, added a fifth class, or Académie des Sciences Morales et Politiques. This constitution was continued under the Emperor Napoleon III. These various classes or academies have published numerous valuable memoirs and reports. Each year a sum is voted by the French government for the general fund of

the institute, and from this fund are paid the allowances of members, salaries of secretaries and other officials, several prizes, and the expense of experiments and printing. Many eminent Englishmen are foreign associates, and a still greater number are correspondents of the institute.

IN'STITUTES. The *Institutes of Justinian*, one of the three parts of the famous CORPUS JURIS CIVILIS drawn up under the Emperor Justinian in 528. The Code was a collection of laws, the Digest a collection of test cases, the Institutes a treatise on the fundamental principles of law. The last-named work is in four books. It professes to be of an elementary character, but its influence on the world has been incalculable. Even as late as 1883 the very important works of Professor Holland and Mr. Moyle (two volumes) appeared from the press of the University of Oxford, the first a new edition of the Institutes, the second a new edition with copious introductions, commentary, excursus, and a racily idiomatic translation, quite unusually free from the sense of "second-handedness" which usually clings to such things. Roby's "Introduction to the Digest" came out at Cambridge at about the same time, and Holland's Digest—selections only—also appeared at Oxford. The opening "legal maxims" (*juris præcepta*) of the Institutes must always strike one as very dignified bases for a theory of law. *Honeste vivere* (to live uprightly) seems to point fairly enough to the duties of one's particular function as a member of the state and of a family; *alterum non lædere* (to do others no injury), to respecting what are now called the primary rights of others, or rights availing against all the world; and *suum cuique tribuere* (to pay each man his own), to the satisfaction of claims which a man's neighbour brings against him, not as one of the public merely, but as having undertaken a special liability. These are also elements, though only elements, of a true legal classification. The resemblance to the division of moral duties in our own church Catechism is striking enough; indeed, it is difficult to think that the framers of the Catechism had not in their minds a phrase which every civilian must have known by heart. But the Catechism itself has a semilegal character. And though it is true that in sundry ways one may hurt others by word and deed, and deal untruly and unjustly, without coming in danger of the law, yet it remains no less true that the purpose of the law is to reinforce morality so far as it can; and to affect ignorance of the moral foundations and purposes of positive law would be the very pedantry of formalism. These "precepts" hardly pretend to be legal rules in the strict sense; they are, as Savigny, who is the great German authority on Justinian's legislation, says—"sittliche Vorschriften, worin Rechtsregeln ihre Grundlage haben," the moral postulates in which legal rules find their basis.

Institutes of Charles the Great.—These were church decrees, not legal discussions. Charles the Great assumed to legislate for the church as despotically as he legislated for the state. He treats the clergy as he treats his secular vassals. He forbids the great ecclesiastics to keep hounds, falcons, jugglers, &c., to drink too much wine, to waste church property; he orders that every religious person shall be under the control of the bishop, whether he belong to the secular or the regular clergy. Even during Charles' life his Institutes were perpetually evaded and his vigilance defeated, but after the heavy hand was withdrawn they fell to pieces almost at once.

IN'STRUMENT OF GOVERNMENT was the title given to what in these later days we should call the constitution, under which Cromwell in 1653 became Lord Protector of the Commonwealth of England, Scotland, and Ireland. Carlyle describes it as a careful constitutional piece in forty-two articles. Among other things it decreed a standing army of 30,000 men. As the oppression of a permanent force had never been before felt by England the army became unpopular, being also, as it were, the type of Puritan domination; it was therefore disbanded at the Restoration, and only 5000 guards allowed the king. Triennial parliaments formed another proviso of this "careful constitutional piece," with 340 members for England, thirty for Scotland, and thirty for Ireland, the possession of £200 worth of property being the qualification for a vote.

The second instrument of government, of 1657, which had made Cromwell king but for his politic refusal, did actually give him kingship save in name only, provided a second House of Parliament, &c. It also conferred upon Cromwell the right to nominate his successor. He exercised his right, and carefully drew up a paper, which, however, at his death could not be found. He was asked on his deathbed whom he had nominated, but his reply was not clear. Thurloe thought he said "yes" when his son Richard's name was mentioned, but it was never sure.

INSTRUMENTA'TION is the art of writing music for several varieties of instruments to play at once. A young composer who is perfectly able to write an unaccompanied part-song must know many technical points connected with the pianoforte before he can even produce a good accompaniment to his song upon that comparatively simple instrument. Still further knowledge of the pianoforte is required before a pianoforte piece can be successfully written. If from this branch he proceeds to attack the composition of a "pianoforte" trio or quartet, he has to learn much about the proper way of using violins, violas and violoncellos, not only the special beauties to be brought out or difficulties to be avoided, but the proper way of contrasting the strings with the pianoforte, or one stringed instrument with another. Next he will probably proceed to write for the string quartet, where the means of contrast are more delicate, and the difficulties correspondingly greater. Finally he attacks the varied mass of tones of the orchestra alone, in combination with voices, with the organ, &c. The considerations governing this complex task are the province of instrumentation to elucidate.

Before beginning this study the musician must have mastered thoroughly the general elements of composition: harmony, counterpoint, canon, fugue, form, and the theory of music, as well as facility in composition of the simpler kind, as for voices only, voices and organ or pianoforte, organ or pianoforte only, &c.—all these are indispensable. In now attempting to instrument the works he has hitherto composed, the musician does exactly what the painter does when, after having thoroughly mastered drawing, he proceeds to the study of colour. A painter whose drawing is inaccurate, whose perspective will not bear inspection, or whose masses of light and shade are ill-arranged, cannot save himself by his mastery of colour—he is doomed to take inferior rank. Just so with a musician who attempts hurriedly the delights of instrumentation with an insufficient knowledge of music.

In this most difficult of all the musical arts, the first thing is to gain a complete knowledge of every instrument. Not necessarily a practical knowledge, that is to say, ability to perform upon every instrument, though the knowledge of one or two will be necessary. The great master Berlioz was never even a tolerable pianist at any time of his career, but if the pianoforte was required he knew exactly how to use it. The compass of an instrument, its special difficulties of fingering, its weak parts where the tone is ineffective, its fine parts where the tone is at its best, the style of passages which show it off and of those in which it appears to disadvantage, these must all be accurately known for each variety. Then its quality of tone, the instruments it works best with and with whose tone its own tone accords best, or in painter's terms (which are quite as intelligible and as necessary in the one art as the other), its colour and its power in combined harmonies, shades or

tints of colour, must be accurately known. This second knowledge cannot be wholly acquired, as the first can. A diligent student, odd as it sounds, could learn to write accompaniments to songs tolerably well on the pianoforte with very little natural musical capacity. In a similar way young ladies totally deaf from birth ("deaf mutes," as they are called) not unfrequently learn to play the pianoforte that they may accompany their friends when dancing, and this they do without any other sensation than that of the touch of the keys with their fingers and the feeling (not the hearing) of the throb of those vibrations which to more fortunate persons make sound. Not so with the musician who wishes to write for the orchestra. He must have a natural ear for colour: in a complex combination of sound he must be able to pick out the elements of which it is composed, when he is once familiar with them, otherwise he cannot succeed here. Akin to this is the power of hearing tone-colours in idea, so that not only the harmonics of a passage when seen on paper become audible to the mind, but also the special colour of the passage is imagined. There is only one way of acquiring this, as Berlioz (the greatest master of instrumentation that has yet existed) has taken pains to point out, and which is the way he himself acquired it—namely, to learn where some well-known work is to be played, to read the score on paper, to imagine what it sounds like, what difference of colour will be given by the horns coming in here and the flutes there, and so on, and then to go and hear the work actually played, so as to correct the imagination. The last step is to read the score again in the silence of one's study and recall the effects heard in performance.

Having learned the capabilities of the various instruments, their tone-colours used singly and in various combinations in this manner, the composer may set to work with some hope of moderate success, so far as mechanical effect is concerned. The mental effect he produces rests with what modicum of genius he possesses, and is not what we are here dealing with. But he must be careful to write simply and clearly, to keep his body of tone easily audible, not confused, with many independent parts crossing hither and thither, but disposed in broad masses readily distinguishable. If he is not cautious on this side he will tire and perplex his hearers; in trying to say too much he will prevent his meaning being heard. To this end of clearness is directed the practical rule that within certain limits every body of instruments must make good harmony by itself—the wood, the brass, the strings; that is to say, if the wood wind (flutes, oboes, clarionets, bassoons) is playing with the strings (violins, violas, violoncellos, contrabasses) each must be fairly complete as to harmony, the chords must not be split up between wind and strings, &c. The quality of tone of wind and strings is so different that the ear refuses to combine them into one chord, though it gladly hears them as two simultaneous chords of varied colour combining to form a new tone-tint. Not less important is it to see that the middle parts of the register are well filled; a heavy bass or a shrill treble, or worse still, both of them at once, give a thinness of effect only tolerable as a contrast to fuller combinations. The preservation of this balance of tone is perhaps the worst of all the pitfalls in instrumentation—a score so readily gets too thin or too thick. In nothing do the great masters shine more than in keeping a full harmony going, and yet exquisitely varied in its colouration, with a few instruments at a time, refreshing the ear and allowing it to repose for whole pages of score together, in preparation for some mighty crash which is to regain redoubled force by the contrast. It is only the tyro who is miserable unless every one in the orchestra is at work; the great men put forth their full strength very sparingly. Again, the composer must ceaselessly strive to gain variety by contrast. Contrast of rhythm, of figure, and above all of colour, wood against strings, one combination against another; this is an art beyond all rule. "With what do you mix your colours?" might be asked of the musician as it was asked of Opie the painter, and the same reply might be given in his case also—"With brains, sir." Another point is the necessity of writing comfortably for the instruments, avoiding needless trouble and difficulty, and leaving the performer not so harassed but that he can attend to the general effect as well as to his own part. Finally, every great composer manages to find some passage which is grateful and possibly showy for even the humblest member of the orchestra. The trombone will count endless bars, giving a solitary blast here and there patiently and contentedly if he knows that his time, too, is coming when in a few grand phrases he will be able to show what vast majesty lies in his "sacred" instrument (the epithet is Mendelssohn's). What drummer but delights when Beethoven is played—Beethoven, who manages to give solos for the drum? If performers are interested they play well, and if they are not a good work runs great risk of falling flat.

Beyond the four varieties of the human voice, the "family orchestra," the indispensable pianoforte, and the harmonium and American-organ, there lies the king of instruments, the organ, and the mighty varied orchestra, forming the tone-material of the composer. Each of the instruments named, or to be named, is separately and fully considered in this work under its own heading. It is only necessary here, therefore, to enumerate the voices of the orchestra. The chief divisions are the strings, the wood wind, and the brass (with the drums). The *strings* are the groundwork of the orchestra: they have not to take breath, all keys and most styles of passages are alike to them, they blend with everything; these are the violins (first and second), the violas, the violoncellos, and the contrabasses (double basses) which double them at an octave beneath. The *wood wind* is also in four parts, but each of the four has a very distinct colour, much more distinct than the delicately varying colours of the strings. These are flutes, oboes, clarionets, and bassoons; and as they differ so much in tone they are always found in pairs of each, so that they can be used to a large extent independently. The two flutes give a complete harmony of a simple kind, and so do the two clarionets, or flutes and clarionets may join in a chord, &c. The *brass* subdivides into the horns and the other brass. The horns are tuned in the key of the piece, or in a key closely akin. They are always in pairs, because [see HORN] one instrument cannot conveniently play the whole scale, and also because of the same necessity of the horns making harmony as has been just pointed out as affecting the wood wind. They form the connecting tissue of the mass of sound. Their gentle yet penetrating tone, their long-drawn notes hold the orchestra together as nothing else can. The other brass is much more sparingly used. The trombones (usually three, so as to give complete triads in themselves) provide the magnificent bass in full combinations, or join the trumpets in that blare which, coming among quieter tone-colours, has reminded so many persons of the effect of scarlet in a painted picture. Then there are the drums, that is, the kettle-drums or timpani, tuned in fifths (and always used in pairs, tonic and dominant); being retuned as the piece proceeds, according to the chords in which they are required. These make the familiar twelve lines of an orchestral score, and are usually thus arranged, counting downwards from the top of the page—(one to four) flutes, oboes, clarionets, bassoons; (five) horns; (six to seven) trumpets, trombones; (eight) drums; (nine to twelve) violin 1, violin 2, viola, violoncello and contrabasso together. Besides these there are certain less-used instruments. The chief is the harp, whose pair of lines (it uses both staves, like the pianoforte) are usually set, when it is required, between the drums and the violins.

The ophicleide and bass tuba, with the contrafagotto, are employed in large orchestras to deepen the tone of the bass. The side drum is required for military effect; the big drum (bass drum) and cymbals are found far more frequently. The line for these two (often taken by the same performer) is put next beneath the line of the drums (timpani). The triangle is an adjunct played by one or other of the drummers. Voices, solo or chorus, are always written next above the violins, or else next above the violoncellos, in orchestral scores. The organ is inserted next above the basses when required, beneath the chorus if this is also performing. The usual combinations are pianoforte and strings (pianoforte trios, quartets, &c.) and pianoforte and orchestra (concertos); strings alone, either one to a part (trio, quartet, quintet, sestet, &c.) or as a string band; strings and wind sestets, septets, &c., which have single wind parts added to the single strings; and finally, the usual varieties of orchestra. These last are the *small orchestra*, or string band with wood wind, horns, and drums, and the *full orchestra*, with the loud brass added, and further, the bass drum, cymbals, piccolo, flute, harp, &c., as required. In military bands clarionets take the leading part, answering to the first violins in an ordinary orchestra; the wood wind is much increased in size, many varieties of horns are introduced among the brass, and the strings are of course absent. In ordinary brass bands a pair or so of clarionets are usually added to the brass instruments on account of their vastly superior flexibility and to afford variety of colour.

Incomparably the greatest work on the subject is the "Traité d'Instrumentation" of Hector Berlioz, the colossus of the orchestra, which has been well translated into English. Professor Gevaërt, head of the Conservatoire of Brussels, produced a fine treatise on instrumentation in 1863 (French), and Lobe's composition (German, 1867) is yet more thorough. But most readers will find all they desire to know in the masterly little treatise on instrumentation by Ebenezer Prout, modestly called a primer ("Music Primers," London, about 1880), which has put the main points of the matter in a few pages.

INSTRUMENTS, MUSICAL, may be divided into four sorts—(1) *Keyed*, as the organ, pianoforte, harmonium, &c.; (2) *stringed*, as the violin, harp, guitar, &c.; (3) *wind*, as the flute, clarionet, horn. &c.; (4) *percussion*, as the drum, triangle, cymbals, &c. The various instruments are described under their respective names. See also MUSIC (section *Musical Instruments*) and INSTRUMENTATION.

IN'SULATORS. When a body containing an amount of electric fluid or of heat is surrounded by non-conductors, and its contact with other bodies thereby prevented, it is said to be insulated, and the non-conducting bodies are called insulators. The most effectual of these for electricity are caoutchouc, silk, glass, dry fur, gutta-percha, sulphur, shellac, and dry air.

INSU'RANCE. Associations for securing individual members from the ruinous consequences of accidents beyond their own control, and for making provision for widows, children, and other dependent persons, now form a necessary part of the social institutions of civilized nations. Some of these have already been considered under the heading FRIENDLY SOCIETIES, but the more important branches of insurance against fire, marine disaster, and life insurance, remain for consideration in the present article.

Fire insurance as a distinct branch of business in England is of comparatively recent origin, and cannot be traced back further than 1667, the year following the great fire of London. Some of the ancient guilds provided compensation for their members who suffered loss from fire, and in some places the inhabitants of a district or locality were accustomed to render help to any of their number who was thus injured. The earliest efforts to organize a proper system of insurance took the form of underwriting by clubs or combinations of merchants and others, and a regular office for the transaction of the business was opened in 1681 in London. A company was started in 1696 under the title of the Amicable, which, under the altered designation of the Hand in Hand, still carries on business, and there are five existing companies which were started in the quarter of a century which followed, viz. the Sun, Union, Westminster, London, and Royal Exchange. It might have been expected that the great advantage to society of individuals providing against loss by means of small annual payments would have been so far acknowledged by the legislature as to prevent any adverse interference, but in addition to a stamp duty which was imposed before the close of the seventeenth century, an annual duty was imposed in 1782, which was afterwards raised by degrees until it reached about 200 per cent. of the premium, and which was only finally abolished in 1869.

The business of fire insurance cannot be founded upon such exact data as that of life insurance, but sufficient experience has been accumulated to enable it to be carried on successfully at a very small cost to the persons assured. The rates of premium charged by the best companies vary from a minimum of 1*s.* 6*d.* per £100 insured, which is the rate for dwelling-houses of the first class and ordinary private furniture, up to six or seven guineas per cent., which are charged on some descriptions of corn mills, sugar refineries, and dye-works. When it is considered that the risks undertaken by the companies are always changing, and the enormous losses that are every now and again sustained by conflagrations in the crowded portions of great cities, it seems almost surprising that the business should be as profitable as it is for the companies, and on the other hand, that any person should neglect to secure his possessions by so easy a method. It is not possible to give any exact figures as to the amount of business of this kind transacted in Great Britain; but in 1868, the last year in which duty was paid, the amount insured was £1,430,000,000, and it may now be estimated as exceeding £4,000,000,000. The amount of property insured in London alone is about £700,000,000.

The modes of effecting fire insurance are too well known to need explanation here, but it may be mentioned that the contract is one of good faith, and it is the duty of the insured to fully disclose all special circumstances of risk attaching to his property, and any change of circumstance affecting that degree of risk, in order to secure the validity of his policy. When the conditions of the policy are carried out, the insured is guaranteed against loss by fire to the extent of the amount insured for, but the loss is reckoned on the value of the property at the time when it was destroyed, and it is in the power of the company to elect to reinstate property instead of paying the value of it. No person is entitled to make any profit by the occurrence of a fire, but as it is the practice of the companies in the general way to give compensation in the form of a money payment, it has been found that there is a sensible increase in the number of fires whenever trade becomes depressed. The returns of the London Fire Brigade furnish some valuable statistics as to the causes of fires, and it is not too much to say that at least one-third occur under suspicious circumstances and for unknown reasons.

Life insurance companies are divided into three kinds—mutual, proprietary, and mixed. A mutual company is one in which the members stand bound to each other and constitute the company themselves. In such companies no capital was formerly required at the outset beyond the necessary expenses of starting, and a small sum by way of guarantee for the first two or three years of working; but by the Acts of 1870, 1871, 1872, a deposit of £20,000 is required by the government from all new companies, which

is to be retained until the life-insurance fund accumulated out of the premiums amounts to £40,000. In a mutual company the whole of the profits are divided among the assured after due provision for a reserve fund.

A proprietary company is one in which a body of proprietors raise a capital and pledge it for the payment of claims in case the premiums are not sufficient; for this security they receive, in addition to the interest of their own capital, the profits of the business. We have spoken of this form of company in the present tense, and such a company, if it could be started and carried on, would be a lawful undertaking, but in practice there are now no strictly proprietary companies, such as formerly existed having either disappeared or altered their mode of business.

A mixed office is one in which there is a proprietary company which does not take all the profits, but only a share of them, the rest being divided among the assured, who in return for the loss of a portion of the profit gained have the additional security and use of the proprietary capital.

It would, of course, be quite out of our province to attempt to define the respective merits of the different systems. Both have their energetic advocates and supporters, but the difference in actual practice is hardly sufficient in itself to determine the choice of an office. In respect to the principle upon which life assurance is conducted, we may observe that an assurance of £100, or a contract to pay £100 at the death of a given individual, is £100 in reversion to the executors of that individual.

The value of a reversion depends upon the value of the corresponding annuity; that is, any given sum, say £100, to be received *when* a given event arrives, depends for its value upon that of £100 a year to be received *till* the event arrives. Suppose, for example, that money makes 5 per cent., and that an annuity, say upon a life, is worth fourteen years' purchase: that is, £100 paid a year hence, and again two years hence, and so on as long as the life lasts, is now worth £1400. Required the value of £100 to be paid at the end of the year in which the life drops. We must now reason as follows:—Suppose a perpetual annuity of £100 a year is to be enjoyed by A. during his life and by his legatees after him. By hypothesis A.'s portion is now worth £1400, and (money making 5 per cent.) the annuity for ever is worth twenty years' purchase, or £2000; consequently the legatee's interest is *now* worth £2000 minus £1400, or £600. But at the end of the year of death the legatee will come into £100 current payment and a perpetual annuity worth £2000, for the remainder of a perpetual annuity is also a perpetual annuity; his interest will *then* be worth £2100. Hence we have ascertained that £2100 at the end of the year of death is now worth £600; and the rule of three then gives the value of any other sum; thus £100 at the end of the year of death is now worth 600 divided by 21, or £28 11*s.* 5¼*d.*

A premium differs from an annuity in that a sum is paid down, and also at the end of every year; consequently it is worth one year's purchase more than an annuity. In the preceding question, the annuity was worth fourteen years' purchase; consequently the premium now is worth fifteen years' purchase. But the present value of all the premiums is to be also the present value of the reversion, or £28 11*s.* 5¼*d.*, whence the premium should be the fifteenth part of this, or £1 18*s.* 1*d.* Hence to find the premium, divide the present value of the reversion by one more than the number of years' purchase in the life annuity.

In the construction of a table of premiums, three points must be left to the judgment of the constructor—the rate of interest, the table of mortality, and the addition to be made for expenses of management and probable fluctuation, or discrepancy between the predictions of the table and the events which actually arrive. The rate of interest to be assumed is an element which requires the greatest caution. It must be a rate which can actually be made, and therefore prudence requires that it should be below that which may reasonably be looked for.

The rates of mortality are based upon elaborate tables which have been compiled from time to time for this express purpose. One of the first of these to be generally used was the Northampton table, constructed by Dr. Thomas Price from the registers kept in the parish of All Saints, Northampton, for the years between 1735 and 1780. The still more celebrated Carlisle tables were constructed by Mr. J. Milne from the observations of Dr. Heysham of Carlisle, and though they were based upon less than 2000 deaths they were found to correspond so closely with the actual experience of the associations that they retained their popularity until a comparatively recent period, and are still used largely for comparison. Later tables are the Seventeen Offices experience tables, the English life tables of Dr. Farr, based upon the official records of the registrar-general, and those derived from the accumulated experience of the Institute of Actuaries. As a result of the valuable work done in the preparation of these tables the liabilities of life insurance offices when spread over a series of years can now be calculated with such mathematical accuracy, that if the premiums have been properly arranged, and the office has been honourably managed, failure is next to impossible. Unfortunately, however, these conditions have not always been complied with, and the huge failures of the Albert and European companies led to the passing of some important measures in 1870, 1871, and 1872. One provision of these Acts has already been referred to, and other regulations are to the effect that when other business is transacted by an office the accounts for life insurance and annuities are to be kept perfectly distinct, and no losses by fire, &c., are to be paid out of the life insurance fund. Annual accounts and periodic valuation reports and statements have to be rendered to the Board of Trade to be annually laid before Parliament, the amalgamation of companies is placed under judicial regulation, and arrangements are made by which the winding up of insolvent companies can be compelled, or their contracts can be reduced so as to come within their means.

With respect to the methods of life insurance generally adopted, the most common is that of the whole term on single lives. The office contracts, in return for an annual payment continued through life, to pay a certain specified sum at death whenever it may occur. Two rates of premium are adopted, the one less than the other. Those who pay the higher rate participate in the profits of the company; those who pay the lower rate have nothing but the nominal sum for which they assure. If the table of lower rates yields a surplus (which it is supposed it will do), that surplus goes to augment the final receipts of those who have a participation in the profits. Another method of insurance now becoming very common is that in which the payments are calculated for a definite term of years, and the amount assured for is paid over to the person insuring when he reaches a certain specified age, or to his representatives at his death, if that occurs any time before. By this means provision is made for old age as well as for premature death, and these policies form an excellent method of saving money. While, however, whole term and endowment policies form the bulk of the business, many other forms of insurance have been devised, such as those on joint lives, for a limited period only, and tontine insurances. The profits made by the companies are also applied in a variety of ways to suit the preferences of different classes of insurers. It is unnecessary to enter into details as to these methods, as information upon them (on a more extended scale than is possible within the limits of this work) can be readily obtained from the companies.

An important development of the principle of life insurance was made in 1865, by the passing of the Government Annuities Act, 27 & 28 Vict. c. 43, by which the postmaster general was authorized to insure the life of any person between sixteen and sixty years of age, and guarantee them direct government security for the payment of the sums insured immediately after their death. This Act was enlarged and amended by the Government Annuities Act of 1882, 45 & 46 Vict. c. 51, and persons of either sex may now insure between the ages of fourteen years and sixty-five years for any amount not less than £5 or more than £100. See ANNUITIES, POST OFFICE.

Like the contract for fire insurance that of life insurance depends largely on the good faith of the person insuring, and as a general rule only sound and healthy lives are accepted by the companies. Any concealment of material facts may lead to the forfeiture or invalidation of a policy, and most companies stipulate that no payment is to be claimed when the person insured dies by his own hand or is legally executed. In actual practice, however, claims are often paid in cases of suicide when the event takes place some years after the policy is granted and is caused by unsoundness of mind.

Ordinary life insurance offers protection to the representatives of the insured person, whether death arises from accident or disease, but the dangers to modern life from the former cause have led to the formation of companies who insure against accident only. The Railway Passengers Assurance Company was formed in 1849, and by its means persons were enabled to insure against a single journey by paying 1*d.*, 2*d.*, or 3*d.*, and in 1856 the business was extended to accidents of all kinds. There are now several associations which devote themselves to this special branch of business, and their payments include compensation in the event of illness or disablement, as well as a payment in the event of death when such arises from accidental causes.

Compulsory Insurance.—One of the most interesting experiments in industrial legislation ever attempted was commenced in Germany in December, 1884, when a Compulsory Insurance Act came into force. The purpose of this Act is to make insurance against illness compulsory, not only on the part of the working class proper, but of a much more extended section of the industrial community than had hitherto been included in that denomination. The workman in Germany has to pay not less than 2 per cent. and not more than 3 per cent. of his average daily wages towards this system of national relief. The higher figure is fixed when 2 per cent. is not sufficient to cover the expenses of the relief, but cannot be enforced without the consent of both master and workmen. Local funds must be organized for persons occupied in the same branch of industry, but when this number is below 100 a local communal fund may unite other branches of trade in the same organization. The relief consists of gratuitous medical attendances, bandages, and all necessary medicines and appliances, while after the third day a money allowance is given, equal to half the daily average wage, so long as it does not exceed 3*s.* a day for thirteen weeks. Women get help for three months before and after confinement, and death allowances are made amounting to twenty times the average daily wage of the locality. In exceptional circumstances the benefit of the local fund may be extended, but it cannot be employed to aid widows, orphans, or chronic invalids. What the law does for German workmen, English workmen in a measure do for themselves. But, after admitting the extraordinary influence for thrift and comfort of our FRIENDLY SOCIETIES, it is well known that there are a large number of workmen in England who make no provision against sickness, and thus the operation of a law in Germany which makes such a provision compulsory cannot fail to be a subject of deep interest.

Marine insurance dates from an earlier period than either fire or life, and a regular chamber of assurance is known to have been in existence at Bruges in the early part of the fourteenth century. A system of marine insurance formed an important part of the business of the HANSEATIC LEAGUE, and the Act of 43 Elizabeth, c. 12, for the regulation of the practice, speaks of it as being one of immemorial usage. Unlike fire and life insurance, which is invariably made at the risk of large companies or the government, marine insurance has ever been chiefly in the hands of individuals, and it was not until 1824 that the monopoly previously enjoyed by the Royal Exchange and London Assurance Companies as being the only *companies* that could grant marine insurance was removed. Since then numerous associations have been formed in London and elsewhere, but the bulk of the business is still transacted by individuals. The underwriters of London form a large and powerful society, known throughout the civilized world as Lloyd's, a designation derived from that of a coffee-house kept by a person of that name in Tower Street, Abchurch Lane, and Lombard Street. As to the original Lloyd no information can be gleaned from the records of the past, but the history of the association may be said to date from the early part of the eighteenth century. A summary of commercial intelligence, known as *Lloyd's News*, was published as early as 1696. At present the members of the association meet in the subscription rooms at the Royal Exchange daily, their joint affairs being conducted by a committee chosen from among the subscribers. Agents are appointed at all the principal ports of the world for the collection and transmission of intelligence, their reports being regularly filed and accessible to all the subscribers. The association also maintains a register of British and foreign shipping, a large number of surveyors and agents being employed for this purpose. Wooden ships are divided into five classes, distinguished by the marks A (black), A (red), Æ, E, and I, the A (black) being the highest. Iron ships are certified as $\frac{A}{A}$, $\frac{A}{B}$, $\frac{A}{C}$. An index designed to show the character and whereabouts of a ship, and a captain's register giving a sketch of the career of each officer, are kept constantly under revision. The larger part of the business of Lloyd's is effected by brokers, some of whom act for a number of principals, and they not unfrequently combine the business of underwriting as well. The business of marine insurance is one that requires careful study, and its risks cannot be estimated with anything like the accuracy of those of fire or life. Hence it is very unusual for any one individual to undertake the whole risk of a vessel himself, but such risk is usually divided into small fractional parts, and distributed among a large number of underwriters. Marine insurance is effected either upon a voyage from one port to another, or for a specified portion of time. In order to give validity to the contract, the assured must have an interest in the ship or cargo assured, gambling or wagering by means of a policy being forbidden by statute. In all voyage policies it is an implied condition of the contract that the ship should be in a seaworthy condition at the commencement of the risk, but this condition does not apply to time policies. It might be supposed that such a condition would lead to endless litigation in the liquidation of losses, but in actual practice it is found that it is powerless even to prevent frauds of the most infamous character. In the printed form in use at Lloyd's the risks undertaken include those of "the seas, men-of-war, fire, enemies, pirates, rovers, thieves, jettisons, letters of mart and arrests, restraints and detachments of all kings, princes, and people, of what nation, condition, or quality soever, barratry of the master and mariners, and of all other perils, losses, and misfortunes that have or shall come to the hurt, detriment, or damage of the said goods

and merchandises, and ship, &c., or any part thereof." The risk on a ship is usually taken from the time of the commencement of the voyage until she reaches the destination specified, and has been moored there twenty-four hours in a place of safety; on goods it begins with their loading and ends with their discharge. It is required that the vessel shall keep the regular and usual course, and any deviation without just and sufficient cause will discharge the underwriter from his liability. In cases of wreck or injury it is the duty of the assured to use all reasonable means to secure or protect the property in danger. See also ABANDONMENT, ADJUSTMENT, and AVERAGE.

INTA'GLIO, an Italian word, composed of *in* and *tagliare*, to cut. It is a term of art applied to small works of the gem class, in which the design is indented or engraved, to distinguish them from those in which the subject or device is raised, called *Cameos.*

The Greeks carried this branch of the fine arts to the same perfection which their genius and feeling for the beautiful enabled them to reach in all others to which they devoted their attention; but we do not trace its existence among them to a very remote date. We have no information respecting the process by which the ancient intagliatori (or sculptores) executed works which are now justly referred to as the best examples of the art. The lathe is not described by any ancient writer; but the works themselves seem to afford evidence of its employment, and Pliny refers to the invention of an instrument which he calls "tornum" ("Nat. Hist.," lib. vii.), which may fairly be supposed to mean a turning machine or tool. It is certain they were acquainted with the use of diamond powder.

The modern practice of cutting stones in intaglio is by an apparatus similar in principle to the turning lathe, which gives the cutting tool, placed horizontally, a quick rotatory motion; and the stone on which the design is to be engraved being brought in contact with it, the surface is ground away or indented, till the effect required is produced. Instruments of various sizes are used, which can easily be removed and replaced; and it is usual, during the process of engraving, to supply the points of the tools with diamond-dust mixed with a little sweet oil. As the work proceeds proofs are occasionally taken in wax.

Engraving dies for coins and medals is an important branch of the art of intaglio, and requires great care and skill for its perfection. The die is made of finely prepared and tempered steel. When the first intaglio, or original die, is executed, it forms a *matrix* (or mould), into which a conically formed block of softer steel is compressed, the matrix first undergoing a process by which it is hardened. An impression taken in this way is called a *puncheon.* When this is completed (and frequent annealing and re-striking are necessary before it is perfected), the engraver retouches the work, now in relief, and gives it all the delicacy of the original model; the metal is then hardened, and by pressing this puncheon into other steel which is soft (by almost a repetition indeed of the before-mentioned process), it serves for the purpose of making the dies for coining.

IN'TEGER, a whole number, as distinguished from a fraction.

INTEGRA'TION, INTEGRAL CALCULUS. The integral calculus is the inverse of the DIFFERENTIAL CALCULUS; that is to say, if A being given, it be a question of the differential calculus to find B; then B being given, it is a question of the integral calculus to find A.

The question of finding a differential coefficient requires the attainment of the limit of the ratio of two simultaneously diminishing increments of y and x, y being a function of x; and therefore the fundamental principle of the integral calculus is as follows:—Knowing the limit of the ratio of the increment of y to the increment of x, required the function of x which y is. Or, having given a function of x, required that function of which the given function is the differential coefficient.

But though this view of the fundamental question is sufficient in pure mathematics, it is not calculated to connect the process of integration with those conceptions which the mind employs in application to geometry or mechanics. We are here accustomed to a rough species of integral calculus, with which the preceding seems at first to have no connection. Thus a number of small straight lines joined together appear to compose a curve with sufficient exactness; we arrive at the calculation of a body's variable motion by supposing it uniform during small intervals, and accelerated at the end of each interval; and we obtain the area of a curve with any degree of exactness by subdividing it into a large number of small curvilinear areas, for each of which we substitute a rectangle. It should seem, then, that when making the proper use of the terms, we say that every magnitude is made up of an infinite number of infinitely small parts, we might add that every one of the parts is of a more simple kind than the whole. Thus we appear to have a right to say that a *curve* is made of infinitely small *straight lines;* that *gradual* variable motion is made up of infinitely small separate *impulses;* that the area of a *curve* is made up of infinitely small *rectangles.* A correct understanding of this connection is the key to that of the integral calculus, and most completely so to that of its ready application.

An integral is said to be definite when its limits are given, and indefinite when they are not given.

The integral calculus, and its inverse, the differential calculus, together form the main body of the *infinitesimal calculus*, which in all essential portions we owe to Leibnitz. Newton's method of FLUXIONS has become absorbed in this more convenient calculus. In the calculus numbers or values are considered not as increasing or decreasing by settled definite steps, however small, but by indefinite infinitesimal steps, so that they may be regarded as *fluents.* In proceeding from 1 to 2 we may pass through the stages $1\frac{1}{4}$, $1\frac{1}{2}$, $1\frac{3}{4}$, or through the stages $1\frac{1}{8}$, $1\frac{1}{4}$, $1\frac{3}{8}$, $1\frac{1}{2}$, &c., or through the stages $1\frac{1}{16}$, $1\frac{1}{8}$, $1\frac{3}{16}$, $1\frac{1}{4}$, &c., but however small we take the difference it is yet perceptible in amount. The calculus assumes an imaginary quantity, styled a *differential* (whence Leibnitz's name), which though so small as to be infinitesimal, yet by continually being added in infinite numbers arrives at length at the variation desired. If a man place grains of sand touching each other along a line, he will cover the extent of a mile after a time, though the advance of each grain may be regarded as imperceptible. But the number of differentials to be added in order to pass from 1 to 2, or from 1 to $1\frac{1}{4}$, or from 1 to $1\frac{1}{16}$, or from any number to any other number, however little greater, is by hypothesis infinite; therefore it follows that any finite number of differentials added to any finite quantity produces no increase in that quantity. This, of course, is pure hypothesis, absolutely impossible in fact, and serving only as a link for calculations.

Let two quantities vary, x and y, and let

$$(1) \quad . \quad . \quad . \quad . \quad . \quad y = \mathrm{F}x,$$

where F is any *function* of x, such as $\tan. x$, x^3, &c. Now for y take $y + \mathrm{D}y$, and for x take $x + \mathrm{D}x$ in like manner; then we have

$$(2) \quad . \quad . \quad . \quad y + \mathrm{D}y = \mathrm{F}\,(x + \mathrm{D}x),$$

whence combining (1) with (2) we easily get

$$(3) \qquad . \quad \frac{\mathrm{D}y}{\mathrm{D}x} = \frac{\mathrm{F}\,(x + \mathrm{D}x) - \mathrm{F}\,(x)}{\mathrm{D}x}.$$

Now the smaller we take $\mathrm{D}x$ and $\mathrm{D}y$ the nearer we approach to actually vanishing. Let them be upon the point of vanishing, and let them then be equal to dx, dy respectively. Then dx and dy are two of the infinitesimal

quantities of which we have spoken above, and are the differentials of x and y. Therefore we have

$$(4)\quad \frac{dy}{dx} = \text{limit}\,\frac{Dy}{Dx} = \text{limit}\,\frac{F(x + Dx) - F(x)}{Dx}$$

Now as the last of these three equalities, though complicated, is still a function of x, call it $F'x$, then we have

$$(5)\quad \frac{dy}{dx} = F'x.$$

If all this process were gone over again, using this in the same manner as the original function of x, namely Fx, we shall get a second function of x which, in like manner, we may express by $F''x$. We may go over it a third time and get a third function of x, which we should call $F'''x$. $F'x$ is called the first differential coefficient, and $F''x$ the second differential coefficient of Fx, or of y, since by (1) $y = Fx$.

The integral calculus, in its simplest form, has for its object to eliminate Fx from the equation (5) and to solve similar problems. Its actual operations cannot be shown in the limits of this work; but an equation of differentials being given it has to find the integrals or primary quantities. The treatises on the subject show various different modes of attack which may be used, though no rules covering all cases have as yet been found—probably are impossible; but integration in many cases is found after using all known devices to be absolutely impossible. The theory of the motions of the heavenly bodies of our system is entirely worked out by the various methods of the integral calculus. Problems involving the areas of curved surfaces or the solid contents of curved bodies also require the integral calculus for their solution.

INTEGRA'TION, FINITE. By this term is meant the summation of any number of terms of a series which follows a regular law.

IN'TELLECT, that which perceives and understands, comprehending all the cognitive powers of the mind, in contradistinction to the active powers of the will. In the Aristotelian philosophy the intellect first works on the phantasms, and discerns by a spontaneous energy what in many is one, what in things dissimilar is similar and the same. By this means it attains to a new kind of perceptions more comprehensive than those of sense; and each of these general ideas subsists entire in each individual of an infinite multitude without losing its own unity and permanence. On the other hand, it is the source of those primary principles on which all science rests, as conversant about universal and demonstrable truth.

The critical philosophy of Kant distinguishes the intellect into two faculties, understanding and reason. The understanding acting on experience merely compares, judges, and measures its representations, and is conversant solely with their mutual limits and relations, classifying them according to certain schemes of its own which are called categories. While, however, the understanding is thus limited, the activity of the reason is unbounded, and, as the principle of principles, it is the base and the verification of every special principle and reasoning.

The usual view of the intellect at the present day is that it is one of the three great divisions of the mind, which, perhaps, Sir William Hamilton was the first to develop in all their clearness and simplicity—namely, feeling (sensation and emotion), will, and thought or intellect.

Intellect, thought, cognition, as it has been variously styled, is said to contain the powers of perception, memory, conception, abstraction, reason, judgment, and imagination. But upon a sounder investigation it is analyzed into three functions, from the operations of which all the varied powers just enumerated arise; these three operations of the intellect are—(1) consciousness of *difference*, or perception of diversity; (2) consciousness of *agreement*, or perception of similarity, and (3) *memory*. Any and every fact of thought will be found to be explicable by one of these three modes of thought. The articles ASSOCIATION OF IDEAS, DIFFERENCE, IDEA, IMAGINATION, &c., show the manner in which this analysis is worked out.

INTEM'PERANCE may be defined as the want of moderation or excess in any kind of action or indulgence, but in its ordinary application it refers only to the excessive use of alcoholic liquors, and it is to this use of the term that the present article will be restricted.

The practice of using fermented alcoholic beverages certainly dates from a very remote period, and references to it are to be found in the earliest literature now extant. Thus the fermented juice of the soma or moon-plant is frequently referred to in the earlier hymns of the Rig Veda, and it was believed to impart power to the gods as well as to men. The whole process of wine-making may be seen depicted in the wall paintings of ancient Egypt, while from the book of Genesis we learn that the Hebrews ascribed the discovery of wine to Noah, the second parent of the human race. It is also very widely diffused both among civilized and uncivilized peoples, and a great variety of materials are employed to obtain the beverages used. In China, Japan, India, and the islands of the Malay Archipelago rice is chiefly employed, the liquors arrack, samshoo, sacie, as well as the raki used in the Levant, being derived from this source. The kumiss of Central Asia is derived from the fermented whey of mare's milk; and the vodki, so largely consumed in Russia, is made from potatoes. It is unnecessary here to refer to the materials pressed into service by European nations, more especially as they will be found enumerated under the headings of the various liquors manufactured and under ALCOHOL.

The effects of alcohol upon the human system have been subjected, especially of late years, to very careful investigation by physiologists, chemists, and others; but though many important facts have been discovered, the subject has not yet been fully elucidated. Nor is there any general agreement as to the value of fermented drinks taken as articles of diet, some high authorities being disposed to regard them as altogether evil, while others equally eminent defend their moderate use as beneficial and salutary. There is a fairly general consensus of opinion in favour of alcohol as being a medical agent of great value, while there is absolutely no difference as to its injurious effects when taken in excess. Alcoholism, the technical term for intemperance, is fully recognized in the medical profession as being not only a serious disease in itself, but also as the source of many other disorders. The effects of alcohol taken in excessive quantity and in a single act of intoxication, vary according to the nature and quantity of the beverage used and the peculiar constitution of the individual. A very large dose of alcohol acts on the nerve centres as a narcotic poison, causing immediate insensibility. If the spirit has been taken in a highly concentrated form death may ensue in a few minutes; but when the ordinary spirits of commerce have been used, it may follow upon a stupor lasting several hours. The symptoms of an ordinary fit of drunkenness are at the outset a feeling of warmth and comfort, with exhilaration of the spirits. Then the face becomes flushed owing to the weakening of the muscular walls of the bloodvessels by the alcohol taken up into the circulation, and the mind displays its influence upon the brain. The ideas pass at first very swiftly and vividly, but soon become indistinct and confused. The sense of prudence and self-control becomes weakened, and a tendency is manifested towards conduct of a ridiculous or dangerous character. Soon there is evident loss of nervous power over the muscles, the speech becoming thick, the eyes seeing double, the hands err, and the limbs stagger, the victim ultimately falling down in a state of insensibility closely resembling that which attends a fit of epi-

lepsy, which lasts for an indefinite period, and is followed by sensations of pain and depression, headache, thirst, and feelings of sickness arising from the congested state of the stomach and duodenum. While this is the general outline of the consequences of a severe debauch, the effects of alcohol vary greatly with different individuals, and feelings and emotions restrained and concealed during sobriety become revealed during the influence of drunkenness. Some persons seem only to become sleepy and confused, while others are excited and quarrelsome, and the opposite qualities of jovial good temper and sullen unreasonable anger, hilarity and mirthfulness and a maudlin sentimentality or extreme melancholy, are all developed by the same influence. There is great truth as well as satire in the well-known picture by Hogarth, entitled "A Modern Conversazione." The effects of chronic alcoholism or the habitual use of an excessive quantity of alcoholic stimulant are of a very serious character. The whole constitution suffers, nearly every part of the body being affected. The blood displays an increased amount of fat, which it deposits in the more important organs of the body, the muscular tissues, and even the bones. The brain exhibits many signs of degeneration; the liver becomes at first congested and swollen, and afterwards shrunken from cirrhosis; the kidneys sometimes suffer from fatty degeneration and at others display the granular form of Bright's disease; while from the diseased state of these important organs there follow affections of the stomach and bowels, and a liability to attacks of dropsy, apoplexy, and palsy, to pneumonia of a low type, and to rapid consumption. The external and more obvious signs which may be observed by the drinker himself are indigestion and loss of appetite, especially for breakfast. There is a feeling of sickness on awakening in the morning, and very often the muscular tremors which accompany this condition are most marked at the same period. The sleep is disturbed, short, and unrefreshing, and the waking hours are troubled by feelings of depression, headache, noises in the ears, disordered vision, and occasional giddiness. Frequently the signs of this condition are displayed in the face, the cheeks being flabby and bloated, the whites of the eyes tinged with yellow, the eyes themselves are weak and watery, and the nose is red and covered by the papules of *Acne rosacea*. The craving for stimulant becomes more intense as the condition progresses, and each indulgence tends to increase the disorder, until the weakened body of the victim becomes a ready prey to disease, and a premature and often painful death supervenes. The foregoing may seem to be a tolerably long list of the evils arising from habitual excess in the use of alcoholic stimulant; but it is far from being exhaustive, and it will be observed that it relates to the physical effects only, leaving the moral and social consequences out of the question. There is, however, one result of intemperance beyond those referred to that is too important for omission—viz., that a tendency to it is very often hereditary, and the children of a drunken father or mother, if they escape still more serious evils, often display a strong predisposition towards excess. A physician of one of the principal London hospitals, in reference to this hereditary tendency, observes, "We frequently find that of the children of intemperate parents, one is a drunkard, a second an idiot and a third suffers from fits, whilst the remainder exhibit other forms of nervous disturbance."

Among other causes of intemperance, occupation and social influences and surroundings are the most important. The workmen employed by brewers and distillers, draymen, publicans, pot-men, butlers, and travellers for wine and spirit houses, are as classes very liable to intemperance. Sometimes habits of drinking are formed by ladies who resort to stimulants in small quantities when suffering from depression, debility, hysteria, or neuralgia. The relief afforded is often only temporary, and as resort is made again to the stimulant, the quantity has to be increased to produce the desired effect. Again, the squalor and wretchedness by which the poor of the large towns are surrounded have a great deal to do with the intemperance that is so prevalent among them. Living in close, dark, narrow streets, crowded into foul unventilated rooms, imperfectly fed and clothed, and always harassed by the uncertainty of employment, the temporary sensations of comfort, warmth, and excitement induced by alcohol present an almost irresistible temptation, and thus the already existing evils are intensified, and the way is opened for crimes of brutality and violence, and the most complete disregard of natural affection and responsibility.

The removal of intemperance, considered as a social and national evil, is too extensive and complicated to be dealt with within the limits of the present article; but with respect to the conditions induced by chronic alcoholism in individuals it may be observed that much may be done by medical science towards their alleviation and cure. In the treatment it is absolutely essential that there should be entire abstinence from the outset. It is found quite impossible to break off such a habit by degrees, it must be given up wholly and instantly. Then the patient will require, in the place of the stimulants given up, a diet consisting of highly nourishing and easily digested articles of food, strong meat, soups, and the concentrated essences of meat being very useful. The digestion must be assisted by the use of bitter tonics combined with carminatives, and where sleeplessness is persistent and distressing sedatives become necessary. A voyage in a teetotal ship or a period of seclusion in a suitable asylum are most important adjuncts to treatment where they can be obtained. By the 42 & 43 Vict. c. 19 justices may license retreats for habitual drunkards who voluntarily apply for admission.

Intemperance or intoxication cannot be pleaded in law as an excuse for any wrong done by the drunken party, and crimes committed while in this state are punishable just the same as if the criminal had been sober. A contract made during the intoxication of one of the parties is not necessarily void, but it may either be voided or ratified at the option of the intoxicated party after he becomes sober. Innkeepers and all licensed persons are forbidden under heavy penalties to permit drunkenness on their premises or to sell intoxicating liquors to any drunken person, and intoxication exhibited in any public place renders the offender liable to fine and imprisonment. See also DRUNKENNESS.

INTERCAL'ARY DAY or **MONTH** (Lat. *intercalo*, I insert), in the calendar, a day or month inserted out of the usual order, to maintain the full sum of time. Thus every fourth year contains 366 days, or one more than usual, and the extra day is the intercalary day. It was given to February, as that was the shortest month, and thrust in by the Romans between the 24th and 25th days. It still retains that place in the ecclesiastical calendar, but in the civil calendar it is the 29th. The Romans during the republic, reckoning as they did by twelve lunar months and 355 days, required an intercalary month of twenty-two or twenty-three days every alternate year. This was called Mercedonius, and as the pontifices alone knew when it was to be inserted an enormous power was thus given to these men and to their (patrician) families. Of course all questions of interest, of terms of office, of fasts and feasts, &c., were thus for the common people kept matters of chance. Julius Cæsar has the great merit of putting an end to this pernicious system by his famous reform of the calendar.

INTERCES'SION, DOCTRINE OF, held by both Protestants and Catholics as regards Jesus, who is taught as perpetually interceding as mediator between man and the Father, is held by the latter also to include the intercession of the Virgin and the saints as mediating between man and

Jesus. The doctrine is one of some delicacy, because it is not to be held as implying that the sacrifice on Calvary was inefficacious or incomplete, but simply as the necessary outcome of the perpetual manifestation of the love of Jesus, the perfectness of God, and the sinfulness of man. In one sense it might be taken as representing the sacrifice not as past, but as always present; not as temporary, but as eternal; not as finished, but as never-ending.

INTERCOS'TAL (Lat. *inter*, between, and *costa*, a rib), in anatomy, the appellation bestowed upon those blood-vessels, veins, and muscles which lie between the ribs.

IN'TERDICT, ECCLESIASTICAL, a mode of censure employed at times by the Roman Catholic Church, by which, in consequence of some offence alleged to have been committed by the people or rulers of a town or country, the pope forbade by a bull the performance of any kind of church rites within the same; the church service was suspended, the sacraments were not administered, and the funeral service was not read. The use of interdicts appears to have originated with the bishops in the ninth century. In the middle ages this measure was often resorted to by the popes in consequence of some serious dispute with the sovereigns of particular countries, and it sometimes had the effect of throwing whole kingdoms into consternation, and even into a state of rebellion, by which the refractory sovereigns were obliged to come to terms with the pontiff.

In the course of time an interdict was found no longer to answer its object, so that it became of rare occurrence, and has for a long period been entirely disused as a general measure, although occasionally, in very special circumstances, and to mark the horror of the church for some enormous crime, instances are still recorded in which a particular place or church has been visited with the penalty of a local interdict.

The most remarkable interdicts were those laid upon Scotland in 1180 by Alexander III.; on Poland by Gregory VII., on the occasion of the murder of Stanislaus at the altar; by Innocent III., on France under Philip Augustus, in 1200; and on England, under John, in 1209. The last instance was the ineffectual interdict levelled against Napoleon by Pope Pius VII. in 1809. See also EXCOMMUNICATION.

IN'TERDICT, in the law of Scotland, supplies the place of an injunction from a court of equity in England. It is a prohibitory order, forbidding some act from being done, and it is obtained on the application of the party who would be injured by the performance of the act. It may be issued by the Court of Session, or by the sheriff's court. Interdicts in the Court of Session are frequently obtained for preventing inferior courts, or the courts of limited operation, such as the ecclesiastical courts, from going beyond their jurisdiction.

IN'TEREST, money which is paid for the use of other money, the lender stipulating for a fixed sum to be paid yearly, half-yearly, or quarterly, for each £100 lent, until the money is returned. When this is not the case, and when the money paid for the loan depends upon the success of an undertaking, or any casualty not connected with the duration of life, it is called a *dividend;* when the money and its interest are to be returned by yearly instalments, and paid off in a certain fixed number of years, it is called a *terminable annuity;* but when the payment is to depend upon the life of any person or persons, it is called a *life annuity.*

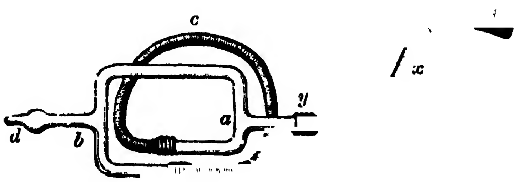
INTERFE'RENCE OF WAVES is a term which, originally limited to the consideration of certain phenomena of water, now extends to light, to sound, and probably to all forms of wave-motion. It comes etymologically from Lat. *inter* and *ferire*, to strike between or to clash against. Interference occurs when one wave system upon a rippling pond encounters another wave system: many points will occur where the crest of a wave in the first system will arrive at a spot just as it is occupied by the trough of the wave of the other system; and the result is a temporary stillness of the water. (If two crests or two troughs coincide the result is, of course, the production of a wave of greatly increased height or depth.)

Interference of Light.—The same reasoning applies to the invisible waves of light. When two rays of light emitted from neighbouring sources meet each other at a very small angle they reciprocally interfere with each other. Thus in a large screen let two small circular panes of red glass (or of any other coloured glass) be placed. The sunlight penetrating these apertures will form two cones of light diverging and enlarging. Let them be caught upon a white surface at such a distance that the cones of red light overlap by their inner edges. It will be seen that the part illuminated from both sources is not evenly coloured, but shows red and black bands alternately. The waves have interfered with one another, and bright streaks and darkness alternately take the place of an even tint. If one of the light-sources is stopped the dark bands disappear. This particular experiment is open to cavil on some small points; but other modes exist of testing the principle, though they are too complicated for treatment in this article, and by them every disputable point is removed. The experiment above is easily tried, and is given here on account of its simplicity. If green glasses, or yellow glasses, &c., be used instead of red (both glasses being of course alike) similar results will ensue, only the distances between the black bands will be different from those in the red form. The explanation is ready; it is because the length of waves differs for each colour of light. If instead of coloured lights white lights are used, then a series of coloured bands is produced. This follows also as a matter of course. For consider the combined light when by interference the yellow waves of the two systems are interfering with one another, so that if both lights were yellow there would be a black band; then, since all the colours are present in white light, this band, unilluminated by yellow light, will be lit up by *all the other colours*, that is, we shall have a purple band. So with the place where when red light is used a dark band would occur, this will now show green, because when from white light the red waves are eliminated the balance produces the effect we name green.

One variety of effects due to this property of interference is given in the exquisitely beautiful phenomena of DIFFRACTION; another series is the curious NEWTON'S RINGS; another result of interference is the formation of *interference spectra*, as described in the article SPECTRUM; and finally, there are the gorgeous coloured fringes due to the interference of rays of polarized light, treated of in the article POLARIZATION OF LIGHT.

Interference of Sound.—Sound is propagated by waves, waves of air, waves of water, waves in solid bodies, &c., but they are waves spreading from a centre in shells of compression and rarefaction, not as light-waves and water-waves, which are waves of transverse oscillation. Nevertheless the same remarks hold good as to the results of interference. When two waves belonging to different sounds coalesce, so that the greatest compression of one wave (trough) coincides with the greatest rarefaction (crest) of another wave, then interference ensues and silence is the result. To reach silence the waves must be exactly half a wave-length apart; and if the sounds are exactly alike in pitch and intensity, so that their waves are equal, and if the one sound starts half a wave-length after the other, and no partials or complementary sounds be produced, then the silence will continue. An example will make this clearer. Two organ pipes are taken which are to be stopped wooden pipes, because the sound is more likely to be simple and the nugatory effect of the upper partials avoided. These pipes are mounted on the same

wind source, and at such a distance apart that the one pipe speaks before the other so much that the sound is exactly half a wave, or a wave and a half, or two waves and a half on its journey before the second pipe is reached by the wind and begins to speak; or by a key the admission of the wind to the second pipe may be withheld for the required space of time. If the pipes are accurately in tune there will be silence except for the buzz of the mechanical concussion of the air, &c. But the least discrepancy in pitch will cause sound to be heard. A still more striking example is shown by means of the apparatus



depicted in the figure. Here x is a long tube ending in a bell (shortened in the figure for clearness' sake); and it must be so long as to enable the nipple d of the apparatus to be easily adjustible to one ear (the other being closed), so that a tuning-fork, or other simple-sound source, when sounded before the bell shall not be audible except through the apparatus. On reaching y the flexible tube x is joined to a hollow metal tube. This tube divides at a, consequently the sound waves are split off into two courses; the upper set of waves travel along the metal tube to b, and there join the lower set, which have traversed a longer path through the flexible tube c. When this latter is accurately adjusted, so that it represents half a wave-length (or one and a half or two and a half wave-lengths, &c.) of the sound of the tuning-fork, then the two sets of waves will neutralize each other, and the ear which listens at the mouth-piece d listens in vain. If the flexible tube c be pinched, and thus closed, the sound becomes audible at once. Supposing the tuning-fork to be the ordinary pitch, C (c'' in the midst of the treble stave), the length of the wave is 2 feet, and the length of the flexible tube c might be 1 foot, or 3 feet, or 5 feet, &c.

But next consider the case of sounds which are of equal pitch and intensity, and whose wave-systems coincide, compression for compression and rarefaction for rarefaction, as in the case of our organ pipes, which now must be sounded simultaneously. It is manifest that we should have a double compression, springing out into a double rarefaction; it is as if in a water wave the trough were twice as deep and at the same time the crest twice times as high as before. It is clear that we have not doubled, we have quadrupled our sound in intensity. But since in practice it is extremely difficult to insure exact simultaneity, exact equality of intensity, and exact identity in pitch, the intensity of a tone when another is added to it varies all the way from the rare quadruple to the equally rare silence. In between these practically non-existent extremes lie any number of means, produced by the algebraical sum of the individual motions of the two wave-systems, now + to +, now − to −; now + to −. If the tones be not of the same pitch, then the phenomenon of BEATS occurs.

IN'TERIM (Lat., in the meantime), a term given to three separate attempts to find a *modus vivendi* between the Protestants and Roman Catholics of Germany in the meantime, that is, until a general council acknowledged by both parties should have settled the affairs of the church and state, as was hoped, permanently. The term was invented at the Diet of Ratisbon, in 1541, when Melancthon discussed with the Roman Catholics a number of points, and found himself much more often in agreement upon substantial points than in disagreement. Except as to the doctrine of transubstantiation and the papal supremacy agreement was arrived at by mutual concessions. But the Ratisbon Interim had very little weight. Melancthon lost almost all influence on account of the concessions he had felt bound to make in a last attempt for peace. The Augsburg Interim was a much more weighty matter. The all-powerful Emperor Charles V., determined to bring peace into the distracted country, submitted a fresh plan to the Diet of Augsburg in 1548, to provide for the reunion of the Protestants to the Catholic Church. Several most important points of liberty of doctrine were granted to the Lutherans, but in main matters of church and state government there was to be a return to the times before 1517. No one ventured to oppose the emperor's plan, and the interim became law, and was enforced throughout the empire. The Lutheran princes submitted at once, and the cities one after the other came in. But Maurice, the new elector of Saxony, being placed by Charles at the head of an army to coerce Magdeburg, which still held out, suddenly changed front, and in concert with Henry II. of France, who with equal secrecy and rapidity descended upon Germany and seized Metz, Toul, and Verdun, turned upon the emperor and found him totally unprepared (1552). The Lutherans rose in all parts of the country, and Charles had to fly for his life. The interim was at an end.

Maurice now tried the Lutheran Interim (Leipzig Interim) which the Protestants had adopted in 1548, closely after the Diet of Augsburg, and which started from the Lutheran views, but admitted much of the Roman ceremonial as optional, and even the supremacy of the popes to a certain limited extent. But the only effect of this well-meant attempt, which the kind-hearted Melancthon, the bosom friend of Luther, warmly supported, was to alienate the rigid reformers and produce a split in the Protestant ranks which has never healed, namely, the final division between the Lutherans who minimize all unessential differences with Rome, and the Reformed churches which substantially follow Calvinistic lines. As to its effect upon Roman Catholics it was absolutely null and void.

INTERIOR OF THE EARTH. This very indefinite portion of the mass of the earth may be defined as that part which is removed from our direct observation. We can therefore speak of its composition and condition with only very doubtful certainty, and our arguments concerning it are mostly based on ulterior data.

From a comparison of the density of the earth, and the mean density of the materials composing it that come under our observation, there can be no doubt but that as a whole it is composed of much heavier material than the crust. The density of the earth's mass is between 5 and 6; that is, it is composed of material averaging five or six times as heavy as water. The mean density of the materials of the crust is from 2·5 to 3, therefore the interior must be composed of material whose mean density is considerably above this average. The density of the interior may be as high as 16, but there is not sufficient available data for accuracy; nor are we acquainted with the law that governs the density of solids under such enormous pressures as they must be subjected to in the interior of our globe; furthermore we are quite ignorant of the condition of that interior, but it may naturally be supposed that the material composing it would be more compressed, and probably much more dense, were it not for the antagonistic effects of internal heat. Reasoning from analogy it may be inferred that when the earth was in a nebulous or fluid condition—as there are many reasons for considering was its early condition—its components, under the influence of gravity and the rotatory motion of the mass, would become arranged according to their relative specific gravi-

ties, the heavier towards the centre, an arrangement that has been accomplished with regard to its fluid envelopes, water and air.

The outer crust of the globe, with which we are acquainted to a total depth of about 10 miles, chiefly through the plication of strata in mountain ranges, consists of a vast thickness of sedimentary strata with intruded masses of igneous rocks. This accumulation rests on a base of granitic rock. It seems not unreasonable to consider this crust as a hydrated and more complexly oxidized outer layer, within which the materials are in more simple combinations or in an elementary state, probably much of the interior consisting of native metals. Furthermore, it seems highly probable that throughout geological time this outer crust has been growing thicker, oxidation penetrating deeper and deeper into the interior, so that eventually our globe may be brought to a similar condition to the moon, without either air or water, both having been absorbed into its solid substance.

That the interior of the earth is in a highly heated condition hardly admits of a doubt; but whether our globe is solid throughout, or that it is only the external crust that is solid, the interior being wholly fluid, or that the outer shell and a solid nucleus are separated by a greater or less quantity of molten matter possessed of a certain amount of fluidity, we are unable to determine from actual observation, and are only able to infer a probability from physical and astronomical considerations. The distribution of land and water on the surface of the earth is very uneven; this favours the idea that the interior of the earth is not homogeneous. The large area of water gathered in the southern hemisphere points to the internal material of that hemisphere being of greater density than that of the northern, else the water there should disperse and become more evenly distributed over the globe. Certain experiments also point to there being heavier material beneath the ocean areas than below the land areas.

In order to explain the phenomena of VOLCANOES, and the plication and disturbance of strata on the surface of the earth, it has been considered necessary that the interior of the earth should be in a molten condition. This idea received apparently considerable support from the ascertained fact that in deep mines and borings the increment of heat of the rock averages about 1° Fahr. for every 50 or 60 feet of descent. At such a rate of increase the fusing point of ordinary rocks would be reached at comparatively moderate depths; but with an increase of depth there is an increase of pressure, which not only raises the fusing point of substances, but reduces the rate of increment, so that it is probable the actual melting of the rocks would only be reached at a much greater depth than at first might be supposed. Sir W. Thomson, who has investigated this subject, believes that the rate of increase would be about 1° Fahr. for every 51 feet down to a depth of 100,000 feet, below which the reduction in the rate of increment would be very sensible. At 400,000, the increment would have fallen to 1° Fahr. for 141 feet, and at 800,000 to 1° for 2550 feet, and so on in an ever-decreasing ratio to about 100 miles, where he considers the interior of the earth is at or about the proper melting point for the pressure and depth.

The similarity of the products of volcanic action throughout geological time and in widely separated regions is strongly suggestive of their having been drawn from one internal reservoir; and the large areas affected by earthquake shocks show how flexible the crust of the earth is; but the physical and astronomical arguments that have been advanced against the internal fluidity of the earth appear unassailable. Sir William Thomson has shown that the earth must be more rigid than a solid globe of glass, for if it were not the phenomena of the tides would be very sensibly affected, and that even if the crust were as rigid as steel and comparatively thick (500 kilometres) it would yield to such an extent under the influence of sun and moon that there could be no sensible rise or fall of tide relative to the land; while Mr. G. H. Darwin concludes from his investigations that no large portion of the earth's interior can even approach liquidity. The phenomena of volcanoes, and the intrusion of igneous rocks into sedimentary strata, afford remarkable evidence that some portions of the interior are molten, or just on the point of becoming so. These may be simply local masses of fused matter to which volcanoes supply vents, or beneath the crust the material in some places may be just on the point of fusion; on a release of pressure the melting point is lowered, and the material liquefies.

INTERJEC'TIONS are those cries of emotion with which we occasionally relieve grammatical speech. To attempt too precisely to explain them is to restrict their full meaning; to treat them as parts of grammatical speech is absurd. Take the grandest of all interjections, the Hebrew Amen, which at first was a simple adverb, "verily," "yea," and try to translate it by a phrase which shall cover all its ordinary uses. If we say "so be it," we make nonsense of the comminatory service of the Church of England (see the introduction to that service in the Prayer Book), or of the frequent form of invocation at the head of old wills, "In the name of God, Amen." Secondly, the interjection is no part of grammar, it is a relic of ancient savage speech, and is rightly said by grammarians to be *interjected*, "pitched in among," reasonable and logical phrases. Half the interjections cannot even be written. Humph, pshaw, whew, &c., stand for well-known sounds, not much like their printed representatives, but which we all recognize and understand; but each of these, even if it could be expressed by letters, could not have its meaning elucidated under a small paragraph. The interjection is the sob, the shout, even the glance, every passing throb of emotion too rapid or too vague for grammatical expression vocalized. Ill-educated persons speak largely, savages almost entirely, in interjections; it is the language of the dog or the monkey, great masters of simple, rudimentary, interjectionary expression. There is to the full as much meaning in the bulldog's sharp bark as in the ruffian's oath, and of the same import; and the watch-dog's snap of surprise and alarm is superior to the vapid "Hallo" or "By Jingo" in dignity and force.

Interjections are of course divisible into classes following the divisions of emotion. We have those of simple surprise: ah, what, hallo, whew, eh, my, gracious-goodness, &c. Then there are the interjections of pain: oh, ah, well-away, alack, alas, dear me, heigh-ho, &c.; of joy, hurrah, hilliho, &c.; of disgust, fie, pugh, bah, pshaw, fudge, begone, for shame, &c. There is a large class of interjections of protestation, among which are the oaths of profane swearing; less indecent expletives are—indeed, by Jingo, by Jupiter, deuce, zounds, faith, gad. Another large class is that of calls or exclamations: hallo, hi, ho, soho, gee-woa, come-up, hear-hear, st, hush, &c. The interjections of doubt are humph, why, hem, &c. There is, finally, a mass of mere imitative sounds: bow-wow, miow or miaou, gr, towhit-towhoo, &c.; thwack, bang, boom, slap, thud, splash, clank, puff, whiz, &c. Fertile indeed is the coinage of novelists in this regard; every year adds to the stock.

On the other hand interjections are divisible into those which are simple animal sounds, and those which have or have had some meaning as speech. Of the first class are the oh! of pain and of astonishment, the ah! of alarm, the humph! of disapproval, the eh! of doubt. Oh! as prefixed to a noun has two senses: "O James!" would fitly prelude an address to a king of that name: it is a vocative in fact; whereas "Oh, James!" is an emotional interjection. The difference of sense is usually in accurate writers marked by a difference in spelling, as just given. In speech the O

is unaccented, the oh usually strongly accented. The Old English *la* (as in *la leof*, O sir) passed from a simple vocative to the indicatory meaning "behold!" and in fact was confused with *loc* (look), its spelling altering to *lo* as time went on. But it survived as *la* among women and gentle-minded speakers for many centuries; in fact "Law, now!" is yet to be heard as a half-in-earnest deprecatory interjection of tolerable frequency among simpler folk. This is Slender's favourite expletive in the "Merry Wives of Windsor," "Truly I will not go first: truly, la: I will not do you that wrong!" &c. The novelists of the last century give us la *ad nauseam* in the talk of affected young "misses." La had an augmented form in the earliest English speech, *eala*. This got confused with the French *hélas* in Norman times, and so became "alas." But it also survived in a form nearer akin to its old self, as "alack." *Wa*, another Old English interjection, became *wo*, as la became lo; and since *wa* was an exclamation of misery and despair it became confused with woe, the substantive (*woh* in Old English); consequently most persons in reading such passages as "Woe, woe, woe to the inhabiters of the earth," &c. (Rev. viii. 13) imagine that misery is formally predicted, whereas it is simply deplored in an ejaculation. *Wala* was a favourite form, *walawa* also; and the latter soon after Chaucer's time became "well-away." Later on it absurdly degenerated into well-a-day. Combining this with alack, we get to alack-a-day; and this feeble moaning of faint-hearted souls caused them to be stigmatized as lackadaisical. (Earle, "Philology of the English Tongue.")

On the other side we have forms of speech, as Alleluia (praise the Lord), hear-hear (let us hear him), all-hail (healthy or hale may you be), &c., which have lost their grammatical meaning and degenerated into exclamations. The list used to be far more full. Thus all the disagreeable set of zounds (God's 'ounds or wounds), 'slife (God's life), 'sdeath (God's death), ods bodikins (God's body), ifakins (in faith), all derived from the holy mysteries of the mass, have disappeared. Gramercy, formerly classed with them, as meaning "God ha' mercy," is quite conclusively traced now to the purer source of *grand merci*. Deuc (Lat. *Deus*, God) still holds its own more than one would wish, but curiously distorted into the meaning of devil from that of God; and the apparently innocent "dear me!" so beloved of elderly ladies, is simply a secular corruption of *Di mio* or *Deus meus*, exactly parallel with the *Mon Dieu* which it takes Englishmen so long to get accustomed to in its incessant occurrence as the one expletive of polite French speech. The "by Jupiter," "by Jingo" (St. Jingo or Gengulphus), and such forms of speech are sufficiently explanatory of themselves. Those who use them certainly mean neither to invoke a pagan god nor a saint, but usually their speech contains many more elements of which their ignorance is equally profound.

INTERLACK'EN (between the lakes), a small town in the canton of Bern, Switzerland, between the lakes Brienz and Thun—whence its name. It is most beautifully situated on the left bank of the Aar, 26 miles southeast of Bern, and has a population of 4000. It consists almost entirely of hotels and boarding-houses, as within a few miles are many of the most wonderful sights in Switzerland. The inhabitants carry on an enormous trade with visitors in beautiful wood carvings. The surrounding scenery is some of the finest in Switzerland. The principal resort of visitors is the Hoheweg, a handsome avenue of walnuts, extending from the village of Aarmühle to the upper bridge over the Aar. On the south side of this are the old monastery and nunnery of Interlacken, founded in 1130, and suppressed in 1528, surrounded by beautiful walnut-trees. The east wing of the monastery has been used as an hospital since 1836; the rest of the building, with the Schloss added in 1750, is occupied by government offices. The nunnery has been converted into a prison. The choir of the monastery church is fitted up as an English chapel.

IN'TERLUDE, a brief piece of church music for the organ, seldom exceeding a few bars, generally produced extempore, and played between the verses of the hymn or psalm, or between different parts of a service. This, being merely for the purpose of giving breathing time to the singers, should always be short and grave, and in keeping with the psalm tune. An interlude after each verse of a hymn was formerly very common, but is now rarely met with in England. In Germany the interlude is still in favour. On the stage an interlude is a short entertainment introduced between longer pieces, or between the acts of a piece. The term intermezzo is sometimes employed in a similar sense.

INTERMEZ'ZO is, as its name implies, a performance *in the midst of* another performance. As the organ interlude (or between-play, Ger. *zwischen-spiel*) separated the verses of a long chorale, and still does so separate them, so the intermezzo gave time between the acts of a tragedy or a serious opera for the principal performers to repose, and for the strain on the attention of the auditors to be relaxed. That such a practice should destroy the unity of the main composition no one seems to have imagined. All the earlier plays and operas were thus treated, and composers even wrote madrigals as intermezzi for their own works. But frequently an intermezzo would take the form of a sprightly dialogue or duet; and if the fancy of the composer was not exhausted in the slender limits properly at his disposal, he readily annexed the interval after the following act of the main piece wherein to complete the half-finished intermezzo. By about 1650 the intermezzo had grown to independent proportions, and the absurd custom prevailed almost absolutely of performing a tragedy and a farce (intermezzo), or a tragic and a comic opera at the same performance, an act of the one alternately with an act of the other. Eventually Pergolesi's "Serva Padrona" (as is pointed out in the excellent article on this subject in Grove's "Dictionary of Music") was felt to be far too good as an intermezzo, though it is slightness itself, hardly more than two voices and a small string band to accompany them. It was extracted from the sandwich state in which it existed in 1734, and performed separately. At once comic opera sprang into independent existence. But what were the playgoers to do for an intermezzo? Refuge was taken in pantomime and ballet-dancing. It is within the memory of the last generation that operas were performed with such intermezzi in England, while plays were divided by dances or short concerts of songs and instrumental pieces. But gradually the ballet fell to the end of the evening as a separate performance, and the pieces between the acts became in the best theatres appropriate musical comments upon the play in hand, though to the latter remark there are still lamentably large exceptions. But abroad things have not yet much improved; and the writer of this article saw a few years back at La Scala in Milan, the first opera house of Italy, the opera of "Der Freischutz" performed act by act alternately with a pantomimic (dumb show) representation of the entire long drama of "The Duke's Motto:" nay, to make matters insufferably worse for any musician present, one of the acts of "Der Freischutz" was divided for the occasion to provide another interval for the intermezzo!

The term is used in general music to signify a short connecting movement between two larger divisions of a piece.

INTERNAL and **EXTERNAL**, geometrical terms applied to the angles made by the sides of a bounded figure. The angle made by two sides is an internal angle, while that made by a side and a side produced, is an external angle.

INTERNA'TIONAL COINAGE. This inestimable advantage is possessed by two groups of nations in Europe, respectively called the Latin and the Scandinavian monetary conventions. The coins of the Latin convention are made of an agreed weight and fineness, and consequently circulate freely in all the countries belonging to it. These are France, Belgium, Switzerland (*franc*), Italy (*lira*), and Greece (*drachma*). Roumania and some states of South America use the same values for their coinage, though not members of the convention. Austria-Hungary has made an approach to the system by striking 8-florin gold pieces equal to 20 francs, and Spain has adopted some silver coins of like value, the Spanish *peseta* being equal to the franc. The Scandinavian convention regulates in like manner the coinage of Norway, Sweden, and Denmark; but the values have no easy relation to those of the Latin convention. The Scandinavian silver *krone* is about a halfpenny over our shilling.

When the new German coinage was adopted after the great war of 1870 a grand opportunity for an interchangeable coinage between Germany and England was thrown away. The German new coinage, regulated by the law of 1871, gives the *mark* as $11\frac{3}{4}d.$ in the 20 mark gold piece. With a little good-will the 20-mark piece might have been made equal to the English sovereign instead of *5d.* short of it, which is just enough to spoil the free interchangeability of the coins. It is to be hoped that a gold coin may in some short time be agreed to which may be the English *sovereign*, 20 German *marks*, 20 Scandinavian *kroner*, 25 French *francs* (or Italian *lire*, Greek *drachmas*, or Spanish *pesetas*), 5 American *dollars*, and 10 Austrian *florins*. To do this five out of the six denominations must make a little adjustment of value, though but very little is needed. Who is to be the fortunate sixth? There can be no hesitation in saying that England has a right to that post of honour. The English sovereign is more universally known and respected than any other coin. It circulates freely wherever it is found, and it has been longer without any change in weight or fineness than any coin in the world. If such an international gold piece could be agreed upon, each country making such divisions of it as might be most suitable to its needs, the time and trouble saved would be incalculable.

INTERNA'TIONAL LAW. This term was originally applied by Bentham to what is generally called "the law of nations." It is a convenient phrase, but in the strict sense the word "law" presupposes the existence of a legislature to make it, a judicial authority to declare and to define it, and an executive to enforce the decisions of the tribunals. In the case, however, of the assemblage of international usages which are generally called international law, all these three conditions are wanting; and as a natural consequence it follows that though certain leading principles are universally admitted, yet in matters of detail there is nothing like the precision and accuracy which distinguish, or at least ought to distinguish, law as framed by a national legislature and interpreted by a national tribunal. As, therefore, the law of nations is lacking in the one essential element of true law—a binding authority—it follows that international conferences can seldom have anything more than a deliberative character; and this must be so until, by a kind of cosmopolitan agreement, the various nations of the world will unite in compelling individual powers to act, in relation to each other, conformably to certain principles declared to be for the welfare of all. An agreement like this, however, would necessitate such a surrender of national individuality as is extremely unlikely, and might, in fact, be altogether undesirable.

The attempt on the part of many well-meaning jurists to elevate international law to the position of a science cannot be said to have been altogether successful. The views of such jurists always seem to lean to humanity and justice, but how far humanity should be considered is a matter which nations have always insisted on deciding for themselves.

Putting aside the conventional rules which have been devised for the peaceful intercourse of nations (which are only accepted because they happen to be convenient), there is no portion of the law of nations which is not the issue of a struggle of interests. Nations have with undeviating strictness considered nothing but their own convenience, including under convenience the avoidance of conflict with other states; and their differing positions and differing interests have gradually given rise to a small body of admitted rules and a considerable number of vexed questions. The jurist toils to find a moral basis for the views on which they are agreed, and strives to decide on moral grounds the questions on which they are divided; but although in the effort he may stir the intellect of the student, he can have small hope of affecting the statesman, who knows well that in all such questions interest must be the chief determinant. The most important and difficult of the questions he has to do with do not indeed turn upon moral considerations at all; they are questions of public policy, upon which it is not easy to have a confident opinion without experience, and here the jurist is compelled to admit his science is at fault.

Montesquieu, in a justly celebrated sentence of his "Esprit des Lois," has said, "The law of nations is naturally founded on this principle—nations ought in peace time to do each other as much good, and they ought in time of war to do each other as little harm as possible, without prejudice to their own true interest." The question is a favourite one with students of international law, but its interpretation turns after all entirely upon what a state may regard as its "own true interest;" and the measure of progress which has been attained since Montesquieu's time is that civilized states have been gradually brought to take a liberal and enlightened view of their interests, and to see that their interests in most matters are not in conflict with, but identical with, those of nations in general. In proportion as this sentiment becomes rooted in the national mind, so will the influence be increased of conferences like that of Brussels in 1874, which met to discuss how best to mitigate the acknowledged horrors of war.

It is to be hoped that in the most important instance of international law which has arisen of late years—the Alabama claims—a mode of settlement of such questions has been found which will prevent their being so often referred to the arbitrament of the sword. A great deal of controversy, however, took place from 1870 to 1875 respecting the "rules" laid down by the treaty of Washington, all tending to show the almost insuperable difficulty in framing rules which nations will accept as binding upon themselves as well as upon each other in case of hostilities arising. A "general rule" is necessarily of a somewhat ambiguous character; it would probably be interpreted differently by different lawyers in the same country, and would inevitably be variously regarded by several countries. "By the law cometh sin," and laying down rules multiplies possible offences; but by general or ambiguous rules, capable of being interpreted in different ways, we not only multiply possible offences, but we go far to make inoffensiveness impossible.

The Declaration of Paris in 1856 afforded a very remarkable instance in which our country made large concessions with the view of favouring a scheme of international law. See PARIS, DECLARATION OF.

INTERNUN'CIO, a papal envoy to small states and republics, inferior to the nuncio, whose mission is confined to the courts of emperors and kings.

INTERPRETA'TION, in mathematics. This word has come into use as descriptive of a process which it was long customary to employ, though without any express

name. When an algebraical definition is laid down, there is frequently some restriction implied in the manner of making the definition, so that the process to which it leads presents more cases than can be explained by it or were contemplated when it was made. For example, the abbreviation of a, aa, aaa, &c., into a, a^2, a^3, and the rules which spring from it, soon led to such results as, a^{-3}, a^0, $a^{\frac{3}{4}}$, $a^{-\frac{1}{2}}$; which, though they follow from algebraical processes, yet, when they first arrive, are without algebraical meaning. In such a case the process of interpretation enters. The question is, What should such symbols mean? have they a necessary meaning? if not, is there any meaning which will be more convenient than another? A definition has been laid down, leading to results which cannot be explained by it: required the extension of the definition which will enable it to explain its own results.

Examples are found in all works which explain the principles of algebra. The rule always is, let the interpreted meaning of the new symbols be such as will make true the whole of the process by which they were obtained. The case of fractional or minus indices mentioned above is dealt with in the article INDICES, THEORY OF.

IN'TERVAL, the unit of measurement in estimating musical pitch.

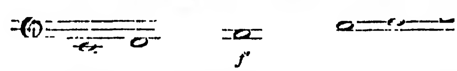
In distinguishing between mere noise and musical sound, we frequently find ourselves face to face with what may be called musical noises, such as the moaning of the wind round the corners of the house in a gale. Suppose in such a noise the rate of vibration of the air remains constant for any appreciable interval, say half a second, we at once get a musical note. We may lose that note again and hear nothing but the ever-varying sound, as it moans now high now low; but for that one instant it was music. If, however, we are fortunate we shall catch the wind steady for an instant again later on, but it is a million chances against one that the rate of vibration of the air shall be exactly the same as it was then. We have therefore a different note from before. The difference in the rates of vibration of these two notes is called an *interval.* Of course the ear does not count sound-waves, any more than the eye counts light-waves; the waves beating c'' with 528 vibrations a second affect a different nerve fibre on the membrane of the cochlea from the waves beating c' with 264 vibrations a second—just as red light with its 474,500,000,000 waves in a second is perceived through the eye, not by the retina counting that inconceivable number of waves, but by its affecting nerve fibres tuned to that rate of vibration, and different from the nerve fibres which vibrate in response to the 699,000,000,000 waves in a second of the colour violet. Regular vibrations of the air, however caused, which occur at the rate of over forty and under 4000 a second (and with musically endowed persons between far wider limits), are felt not as waves beating on the tympanum of the ear but as *sound.* Irregular vibrations between the same limit give noise. Constantly varying vibrations give what we have called musical noise, as the moaning of the wind, &c.

No means of reproducing a sound in idea, and *a fortiori* no memory of it, is possible until it can be fixed and identified; intervals, then, are the very body and soul of organized music. But these intervals are mere steps, which we take of any distance we choose, between certain rates of regular vibration known to us as distinct musical sounds. We might have a fresh interval for every added wave of vibration per second if we pleased, but that would give us 4000 intervals to distinguish, or we might have only notes of forty per second, eighty per second, a hundred and sixty per second, &c., where the intervals are obtained by taking those notes alone which are given by rates of wave-vibration each the double of its predecessor; but here we should only get at the outside eight notes in all for our music, which is manifestly as inadequate a material to work upon as the other is superfluous.

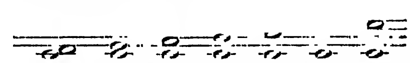
A note produced by a string of a certain length is made by vibrations twice as rapid as those of a string twice the length of the first; halve the string and you double the vibrations. The note of doubly rapid vibration is said to be at an octave interval from the first. The sort of sound is so characteristic that it is known to all; it is simply a shriller repetition of the first sound. There are seven such repetitions of the lowest sound in the eight notes spoken of in the last paragraph, therefore there are seven octaves in practical music. The word octave means eighth note, and this name is given to it among European peoples because the interval between a note and its octave is divided into seven parts, seven intervals requiring of course eight notes to contain them. Let the lowest note of such a series or scale of eight notes be given by 264 vibrations, then the eighth or octave will be given by double the number, namely, 528, and the notes in between will be in our modern musical scale produced by 297, 330, 352, 396, 440, and 495 vibrations per second respectively. We give names to these intervals; we call the bottom note Unison and the seven intervals Second, Third, Fourth, Fifth, Sixth, Seventh, and Octave. Then, regarding the octave as a unison whence to start afresh, we can construct another set of intervals at a higher elevation. The Second in the new octave is often called the Ninth with regard to the original unison whence we started, the new Third is called the Tenth, the new Fourth is the Eleventh, the new Fifth is the Twelfth, and the new Sixth is the Thirteenth. The double octave is often called the Fifteenth. By a confusion of terms, which really produces no confusion of sense, we call the notes and the intervals by the same names in the above series. Thus the word octave means the interval of an octave and also the note at the upper limit of the interval; so with the rest. By naming our notes with letters of the alphabet or depicting them by signs we get further facilities for describing and cataloguing the intervals between them. The following is the musical, alphabetical, and acoustical description of the notes used in our example above:—

Vibrations per second.

264 297 330 352 396 440 495 528



The intervals referred to above may be thus represented, with their characteristic ratios—

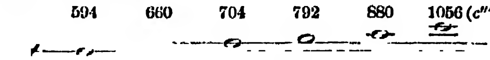


Second. Third. Fourth. Fifth. Sixth. Seventh Octave.

8 : 9 4 : 5 3 : 4 2 : 3 3 : 5 8 : 15 15 : 16

Intervals in the second octave-space reckoned from the original unison—

594 660 704 792 880 1056 (c''').



Ninth. Tenth. Eleventh. Twelfth. Thirteenth. Fifteenth.

(Vibration numbers refer to the upper notes; the lower note is throughout c'' 264.)

The Fourteenth in this secondary series is not required, but the others are all elements of chords; and as they require separate treatment (for instance, the Ninth is in many cases not treated at all in the same way as a Second) it is best to give them distinctive names.

On looking at the intervals between the above notes we see gaps between c'—d' and d'—e', and between f'—g', g'—a', and a'—b' larger than the other two intervals, those between e'—f' and b'—c''. Also on calculating the

ratios we find them to be $c'—d' = 8:9$, $c'—e' = 4:5$, and so on, as marked beneath the second illustration. We get a useful note between d' and e' by taking a rate of musical vibration in the ratio $5:6$ from c', a note with 316·8 vibrations per second, which comes midway between the other two; being below e' we call it $e'♭$, and being less than a Third we call it a *minor* Third. The interval with the ratio $4:5$ which we had at starting is called a *major* Third. In like manner we obtain a note $a'♭$, by using the ratio $5:8$, which we call a *minor* Sixth, which neatly divides the gap between the Fifth and Sixth. The latter, the interval we had at first, we therefore call a *major* Sixth. Proceeding on similar lines we get a *minor* Second, $d'♭$, and a *minor* Seventh, $b'♭$, in addition to the major Second, $c'—d'$, and the major Seventh, $c'—b'$, which we already had. There remains only the large interval between the Fourth and Fifth. This we divide by taking a major Third (4 : 5) from d' and arriving at a note above f', which we call $f'♯$. If we compare its ratio of vibration with that of f' we find it is as 135 to 128. Our intervals have now grown in number from seven to twelve, and the notes containing them are as under:—

c' $d'♭$ d' $e'♭$ e' f' $f'♯$ g' $a'♭$ a' $b'♭$ b' c''.

Nevertheless, as these inflected notes are of much later date and of much less melodic importance than the original eight, the last note of the series is still called the octave, 8ve, or eighth note; and this in spite of its being actually the thirteenth in our modern music. Another result of the original way of regarding the octave as made up of seven intervals (eight notes) is that we still call any interval which is named by letters next each other in the alphabet a Second, and any which is named by letters two apart in the alphabet a Third, reckoning Roman fashion, with both extremes included. Thus c' to d' is a second, even if we alter both c' and d' to any permissible extent. It is found to be of practical advantage in music to be able to inflect any note to the extent of half a tone (equal to one of the twelve intervals just given), thus extending to general usage what we did above when we used $a'♭$ for a note a half tone below a', and $f'♯$ for a half tone above f'. The twelve intervals of the complete division of the octave, all approximately equal in the ratios of the notes which include them, are all called half tones or semitones. We may make them absolutely equal, each of them having the ratio 264 : 279·698, as in the mode of tuning called equal temperament; and then we shall get $c'—d'♭$ equal to $d'♭—d'$, and we can even express the intervening note between c' and d' as $c'♯$, and so with all the other intervals of the entire octave space. Returning to a previous remark we observe, then, that the interval $c'—e'$ (whether c' is left uninflected or is inflected to $c'♭$ or $c'♯$, and whether e' is left uninflected or is inflected to $e'♭$ or $e'♯$) remains always a Third. The intervals $c'♯—e'♭$, $c'♭—e'♯$, &c., are as much Thirds as the original interval $c'—e'$, for they all cover *three* letters—*c d e*.

Rule.—*Intervals are reckoned, then, upwards—alphabetically and inclusively.*

It now becomes necessary to classify the various kinds of Seconds, of Thirds, &c., and in doing this we may deal with the unison as an interval, although strictly speaking it has of course no right to the name. If we take each of the twelve semitones in an octave as equal these afford an excellent gauge of measuring intervals, and this accordingly is the mode adopted. Representing the scale we have been using throughout by the letters C D E F G A B C, and the notes between C and D, between D and E, &c. by a cross +, which may mean either ♯ or ♭ (either C♯ or D♭ for instance), we write the whole thirteen notes of the octave thus:

C + D + E F + G + A + B C.

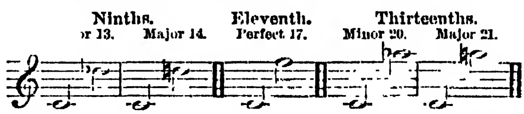
We at once see that a Unison, an Octave, a Fifth, and a Fourth have none, twelve, seven, and five semitones respectively; whereas Thirds may be *major* with four or *minor* with three semitones, Seconds may be major with two or minor with one, &c., and so with Sixths (nine or eight) and Sevenths (eleven or ten). We call the first class of intervals, which have only one form, *perfect;* the others are either *minor* or *major*. Now taking these intervals as normal we get a second rule:

Rule.—*Intervals one semitone larger than perfect or larger than major are called Augmented, and intervals one semitone less than perfect or less than minor are called Diminished.*

We can now construct a table. We shall not require *both* augmented and diminished intervals of each species; for instance a diminished Second (none) is manifestly a Unison, an augmented Third (five) is manifestly a Fourth, &c. Nevertheless if, in writing, such intervals are required for clearness or for special effect, they may be used. We here give only the intervals in common use, the figures being the number of semitones in each.

TABLE OF INTERVALS AND THEIR INVERSIONS.

The intervals chiefly used beyond the octave are the major and minor Ninths, the perfect Eleventh, and the major and minor Thirteenths.



A few considerations on these intervals are necessary. The intervals above given are those used in English music. Other systems of music, as the Arabian, Chinese, Japanese, Javanese, &c., use quite a different set. But the result is that their music always sounds out of tune to us, and is frequently quite unintelligible.

The same relative series of intervals as has been traced out above for the octave beginning at c', with 264 vibrations per second, or *middle C*, could be as easily constructed from c'' with 528 vibrations, or any other C. Also any note, not C, may be taken as the Unison; we may have a set of intervals upon any D, for example. If we start from d', then $d'—e'$ is a major Second, $d'—f'♯$ is a major Third, and so on, using the same ratio and terms of expression relatively as for the c' series given above.

Finally, we have taken c' as given by 264 vibrations per second. This is the pitch adopted by the Society of Arts, and recommended by the celebrated Scheibler. But

we might use the sharp English Orchestra pitch of c'=270, or the flat *Diapason Normal*, the official pitch of France, where c'=261, or the very flat pitch desired by musical theorists because it is a power of the number 2, where c'=256; and from any of these starting-points we might construct our series. But once constructed, the whole of the music, to sound in tune, must be played undeviatingly in the intervals of the series chosen.

The intervals are observed to be bracketed together, Seconds with Sevenths, Thirds with Sixths, and Fourths with Fifths. These are mutually inversions of each other. A Second inverted by placing the lower note above the higher, as in the table, becomes a Seventh; a Seventh is seen to invert into a Second, and so with the other pairs. Further, it will be seen that major intervals have minor inversions, augmented intervals have diminished inversions, and *vice versa*. But perfect intervals have perfect inversions. Other peculiarities of perfect intervals are that (except between B and F) they always have both notes of a like quality, as the Fifths *f*♯—*c*♯, E♭—B♭, &c., or the Fourths *c*♯-*f*♯, B♭-E♭, or the Octaves *c*-*c'* *a*♭'-*a*♭'', &c. Also in harmony two perfect intervals must not succeed one another (except Fourths in an inner part), and they submit to other very important restrictions in musical movement because of their very distinctive characters.

Yet another reason exists for bracketing together these pairs of intervals. Seconds and Sevenths are discords in all their qualities. Major and minor Thirds, and major and minor Sixths, are, however, concords, but they are called imperfect concords, not at all a happy name, but a very necessary one till a better be found. Finally, perfect Fourths and Fifths (with Octaves and Unisons) are perfect concords. (Other qualities of Thirds, Sixths, Fourths, Fifths, and Octaves are discords.)

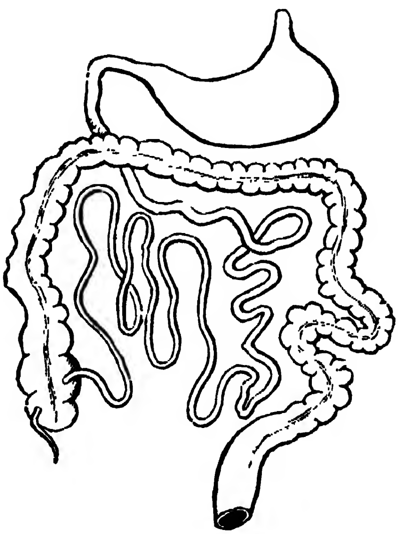
This nomenclature has much to recommend it. It has grown up out of real distinctions, but it certainly has a good many terms. Consequently the Germans have invented one on a more simple basis. The German Nomenclature of Intervals calls—1, all the normal intervals of the scale, as given in the first illustration of this article, *major*. (Our perfect is therefore in German *major*, as well as our own major.) 2. Intervals less than major by one semitone are *minor*. (The German minor includes therefore our minor and our diminished-perfect intervals.) 3. *Augmented* intervals in the German system are those one semitone larger than the German major—*diminished* intervals one semitone less than their minor.

Other terms have been used to characterize intervals, such as *sharp* Fourth for augmented Fourth, *flat* Seventh for diminished Seventh, &c. *Superfluous*, *extreme*, *pluperfect* are other such antiquated terms, which may be surviving here and there, but are rapidly dying out, if indeed by this time they have not altogether disappeared. A diminished Fifth is very often, for reasons of harmony, called an *imperfect* Fifth, but the term diminished is sure to supersede it in time. Finally, it is frequently convenient to speak of the augmented Fourth and the diminished Fifth as *tritones*, or three-tones, since each of them has six semitones. Tritones, whether Fourths or Fifths, have many peculiarities and difficulties in practical use.

INTES'TACY is either the dying without a will, or with a will which does not dispose of the whole of the real or personal estate of the deceased, and therefore there may be either general or partial intestacy. Real estate, not disposed of by will, descends to the heir. [See HEIR; DESCENT.] Personal estate not disposed of by will is distributed in certain definite proportions, the following being the most general. To a wife and a child or children—one-third to the wife and the rest to the child or children; if a wife only, then half to her and the remainder to the next of kin; if a child or children only, then all to him, her, or them in equal proportions.

INTES'TINES are that portion of the digestive canal into which the food is received after it has been partially digested in the stomach, and in which its further assimilation, the separation and absorption of the nutritive matter, and the removal of that which is excrementitious, take place. In an adult man the intestines consist of a convoluted tube of from 25 to 30 feet in length, and are, from the difference of their diameters in different parts, divided into the *small intestines*, which comprise about the first four-fifths, and the *large intestine*, which constitutes the other fifth of their length. The former again are divided into the *duodenum*, into which the ducts from the liver and pancreas open, and in which the chyme from the stomach is converted into chyle; the *jejunum*, in which the absorption of the nutritive matter of the food is principally effected; and the *ileum*. The large intestine or *colon* is named after its course in its respective parts, the *ascending*, the *transverse*, and the *descending colon;* the blind end of it, into which the ileum opens by the ileo-cæcal, is called the CÆCUM; the final or anal portion, from its straight course, is called the *rectum*.

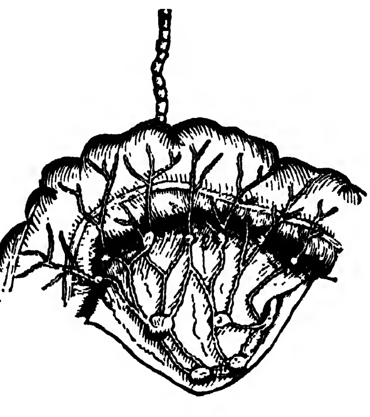
In the figure the small intestine is seen commencing from the smaller or right extremity of the stomach, and



passing to the right side. It lies close below the liver, and turning downward receives from it the gall-duct, and from the *pancreas* the duct bringing the pancreatic secretion, so that

these fluids may mingle with the food; then going across the spine to the left, it twists and forms a great number of convolutions which lie chiefly in the middle of the belly, round about the navel, and finally terminate in the large intestine, in the right flank. In the drawing, the turns are not represented exactly as they are placed in the belly, but as separated and spread out in order to render them distinct. Neither is the small intestine represented by more than half its proper length, otherwise the numerous

convolutions would have made the whole figure quite confused. The whole intestine is lined with a more complex variety of the velvety membrane which lines the stomach, and which is constantly moistened by a mucous secretion. Also its surface is ridged in the first part of its course, so as to expose a large area to absorption. The thickness of the gut is formed of muscular fibres, arranged in two layers, as seen at the left end of the figure, the outer layer being longitudinal and the inner layer circular. When these fibres contract their effect is to narrow the gut, as in the middle of the figure, and at the same time to draw the portion next further down upward to the contracted part, over the contained food, just as one draws up a stocking over the foot that is pushed into it. The effect of the gradual and generally uniform contraction of these fibres is to propel the food downward; and if the belly of an animal newly killed be opened, the bowels are seen moving in the manner of a bunch of earthworms creeping through among one another—whence the name of *vermicular* motion, which has been given to it. It is also called



peristaltic from its circularly progressive contraction. The gall-ducts enter the small intestine about 6 inches after it leaves the stomach; and the moment the bile mingles with the chyme a chemical change takes place, and the separation of the nutritious parts from the refuse begins to go on. A creamy-looking white fluid appears on the surface of the food next to the mucous membrane, and is sucked up by an infinity of small vessels, called the *absorbents*, which will be described by and by. In performing all this process, the obvious use of the great length of the alimentary canal is that every part of the food may be turned about, and be successively presented to the mouths of those vessels, so as to have its nourishing particles fully removed. The food therefore becomes gradually thicker and drier as it passes down, and is stained of a yellow colour from the admixture of bile; but it still remains odourless until it gets into the large intestine, where it puts on the character of *fæces*, or useless matter.

The large intestine is seen to commence by a blind end (CÆCUM), into the side of which the small intestine opens. The ileo-cæcal valve is here placed to prevent the regurgitation of the fæcal matter into the small bowels. From this blind pouch, the great gut (colon) ascends in the right flank, crosses over the belly below the stomach, descends in the left flank, forms a twist like the letter S, and then turns into the pelvis to open outwardly at the anus.

The nourishing part of the food, the *chyle*, is absorbed from the intestines by an infinity of small vessels, having a close affinity to veins, whose ends terminate in the velvet-like pile formed by the *villi*, vascular processes which line the organ. The structure of lacteals is very like that of veins. They are provided with valves, giving them a knotted appearance, to prevent the fluid they convey from taking a retrograde course. They are not more than the thirtieth of an inch in diameter, and are so transparent that they are not visible when empty. If a dog be killed about two hours after a full meal, these vessels are seen in great numbers arising from the bowels, and filled with a white milky fluid, whence they receive the name of *lacteals* (Lat. *lac*, milk). These vessels connect with one another in small glands, and eventually unite at the right side of the spine into an ascending trunk about the size of a goose-quill, which at length pours its contents, containing all the nourishment of the body (except the watery parts, which seem to be taken up by the veins), into the great vein of the upper part of the body, at the junction of the neck with the shoulder, and is thus carried to the heart and lungs.

The special digestive product of the intestines is called the *intestinal juice*, and is secreted by three kinds of glands, named after their respective discoverers—Brünner's glands, Peyer's glands or patches, and Lieberkuhn's glands or crypts. The fluid of Brünner's glands is now held to resemble gastric juice, turning proteids to peptones; and that of Lieberkuhn's glands to resemble rather saliva, turning starch to sugar. (1) The glands or crypts of Lieberkuhn are simple tubular depressions of the intestinal mucous membrane, thickly distributed throughout the whole length of the intestines; their apertures visible only by a microscope in the small intestine, as dots between the villi (the minute vascular processes which give the bowel its velvety look), but becoming larger in the colon, and increasing as they near the anal extremity, till in the rectum their orifices are visible to the eye. In depth these finger-shaped tubules or depressions vary from $\frac{1}{30}$ to $\frac{1}{10}$ of a line. (2) Brünner's glands occur thickly near the stomach, decrease in frequency as they get further away from it, and terminate altogether where the jejunum begins. They are situated in the mucous membrane, and imbedded in the submucous tissue, each gland being a convoluted and branched tube, lined with columnar epithelium, its ducts opening on the surface of the mucous membrane. (3) Peyer's patches are found more or less throughout the small intestine, but particularly in the lower ileum near the ileo-cæcal valve. They usually occur opposite the attachment of the mesentery. They are groups of small glands in oval patches of 1 to 3 inches long and half an inch wide, with the long axis in the direction of the length of the intestine. The glands also occur singly. Each one is a little mass of adenoid tissue forming a lymph follicle, and appears as a spherical opaque white body from $\frac{1}{24}$ to $\frac{1}{12}$ inch in diameter, contained in the submucous coat, but projecting into the mucous membrane, covered with columnar epithelium. Each gland is surrounded by Lieberkuhn's crypts. The interior of a Peyer's gland is traversed by a very rich blood-capillary plexus. Peyer's patches are largest and most prominent in infancy; they decline as age advances, and in adult life shrivel up and almost disappear.

The structure of the intestines is fourfold:—(1) the *serous* coat, which is really the visceral layer of the peritoneum; (2) the *muscular* coat, with an internal circular and an external longitudinal layer, and a nerve plexus between them which regulates the peristaltic action of the organ; (3) the *submucous* coat, chiefly of connective tissue, containing the glands, bloodvessels, absorbents, and a plexus of nerves the whole length of the intestines, regulating the calibre of the bloodvessels and consequently the supply of blood to the organ; and (4) the inner surface, in contact with the food, the *mucous* membrane, rising into ridgy folds in the upper small intestine, and into the velvety villi throughout the small intestine, but not in the large. Between it and the submucous coat is the *muscularis mucosæ*, a thin muscular layer with crossed longitudinal

and circular fibres. The muscular coat (layer No. 2) is peculiarly formed in the large intestine. It is shorter from end to end than the other coats, consequently the organ is puckered up into folds. The longitudinal fibres of the muscular coat are chiefly gathered into three principal bands, one of which is shown in the woodcut illustrating this article, running from end to end of the intestine. If the true length of the bowel be required, these bands must be cut across here and there and the organ drawn out straight. It is then evenly cylindrical in form.

The intestines contain in life a large amount of gas, derived partly from swallowed air, but chiefly from the chemical combinations arising from the decomposition of the food. When in a *post-mortem* examination the intestines are opened and the gases escape the organ shrinks very considerably. It is evidently the gas therefore which causes them to fill out the cavity of the abdomen. No doubt it fulfils a definite purpose, which as yet is not quite clear, beyond the mechanical assistance it affords in equalizing pressure.

The whole of the contents of the belly are covered with a thin shining membrane, called the *peritoneum*, which also lines the boundary walls of that cavity. It is of the same nature as the membrane which lines the chest and covers the lungs, and as that which surrounds the heart. Its smooth polished surface is evidently intended to permit the constant gentle motions of the bowels to go on easily, without our being at all sensible of them. This surface is kept moist by a thin liquid, the evaporation of which is the reason why the body of an animal newly killed is seen to smoke when opened and exposed to the air. When this fluid is poured out in too great quantity the bag of the peritoneum becomes distended with it, and constitutes the disease called dropsy. When medicines have no effect in reducing this, it becomes necessary to tap the patient; that is to say, to insert a small tube with a sharp point into the cavity of the belly, so as to permit the water to run out. This membrane is exceedingly liable to become inflamed, and when inflammation does come on, it runs a very rapid course, and generally proves speedily fatal. It is from this inflammation that many of those females sink who perish after child-bearing.

INTONA'TION, in vocal music, is the tuning of the voice—the singing true or false, in tune or out of tune. Correct intonation is the first requisite in a singer; this wanting, all his other musical qualities, however good, are unavailing. *Intoning* is the peculiar style of chanting adopted in certain churches for particular portions of the liturgy, which are sung upon one long-drawn note.

INTRENCH'MENT, in military matters, is a ditch or trench dug for temporary defence, with a parapet of earth thrown up for protection. When the ground is loose or sandy, fascines, gabions, or bags filled with earth or sand are employed to consolidate or strengthen the work.

IN'TROIT (Lat. *introitus*, entry), in church ritual, the verses chanted or repeated when the clergy first enters the church—a custom as old as the fourth century, but only lately revived in the Protestant (Anglican) form of worship.

INTRU'SIVE ROCKS are those igneous rocks which have been intruded or injected into other rocks, either igneous or sedimentary. Having cooled slowly, and consolidated under pressure, at some distance beneath the surface of the earth, the mineral constituents have mostly crystallized out; so there is a general tendency to a coarsely crystalline texture. These rocks are also called *Plutonic* or *Irruptive Rocks*. As a class they are opposed to *Volcanic* or *Eruptive Rocks*, which have been ejected on the surface of the earth, and cooling there more rapidly and under less pressure they are less devitrified, and are more finely crystalline and vitreous.

Intrusive rocks, though as a rule largely crystalline in structure, have their felsitic and more or less vitreous varieties; they are, however, never vesicular, slaggy, cindery, nor amygdaloidal. In the crystals, and especially in the quartz crystals, water cavities are plentiful, showing the original presence of water or hydrothermal agencies in the formation of the rock. Intrusive rocks are unstratified; they may occur in *bosses*, or amorphous masses; in *dykes* or *veins*; in *intrusive sheets*; or in *necks*, or the filling-in of old volcanic vents.

(1) In *bosses* the rocks are generally more coarsely crystalline than in the other forms, but these bosses usually send intrusive veins into the surrounding rock (see Plate, figs. 1, 2, 3), and it is highly probable that if the other forms, intrusive sheets, necks, and dykes, were traced to their source, the root in all cases would be an amorphous mass of granitic or coarsely crystalline rock. The rocks most usually occurring thus are granite, syenite, diorite, miascite, gabbro, &c., with their several mineralogical deviations. They are termed *granitic* or *granular-crystalline* from being wholly composed of an aggregated mass of distinct crystals, woven together without any interstitial vitreous paste or glassy magma. They are mostly coarse-grained, speckled or mottled rocks in appearance; acid, intermediate or basic in composition; and besides occurring in bosses sending off tortuous veins, they often occupy the axis or peak of a mountain range (see Plate, fig. 4), where they are considered to be the result of the intense metamorphism of sediments or of some pre-existing volcanic rock. Granite may be taken as the type of this class; it is the most widely distributed, and a rock with which most are familiar. The following remarks concerning it, except those relating to its composition, are mostly applicable to the other varieties of granitic rocks.

Granite (Lat. *granum*, a grain) is a crystalline granular rock, composed typically of an admixture of quartz, felspar, and mica, in tolerably uniform grains (each mineral being thoroughly crystalline in character), with no interstitial, amorphous, or crypto-crystalline ground mass (see Plate I. GEOLOGY, fig. 4).

The *quartz* has a glassy appearance, but varies much in colour; it seldom occurs as distinctly formed crystals, but generally as small "blebs," or filling the interstices of the other minerals, as though it were the last to solidify. It frequently contains liquid cavities.

The *felspar*, typically orthoclase, is usually white or pink; but plagioclastic or triclinic felspar (albite and oligoclase) not uncommonly replace it in whole or in part. The felspar often occurs in distinctly recognizable forms, and the orthoclase is frequently in twins of the Carlsbad type. Sometimes the felspar composes the mass of the rock, the other minerals occurring scattered through it. The felspar has an opaque white appearance, and can be scratched by a knife, while the quartz cannot. Oligoclase has a more amorphous and waxy appearance, and is seldom in well-defined crystalline forms. The triclinic felspars may generally be recognized by their numerous parallel striations on the basal plane, indicative of the repeated twinning. The felspar is the constituent most liable to undergo decomposition, causing disintegration of the rock and the formation of growan and china clay or kaolin. On the nature of the felspar therefore the durability of the stone is largely dependent.

The *mica* is most usually either the potash variety muscovite, or the magnesia variety biotite; but other species are not uncommon, as lepidolite and lepidomelane. In some granites it occurs in large well-defined crystals, in others as minutely disseminated scales, which may be aggregated in groups or clusters, or arranged in a plumose fashion. Segregation and mineral veins often occur in granites; in these not only the constituents but accessory minerals occur in well-defined specimens.

The accessory minerals, as a rule, are of subordinate importance in a granite; some are injurious to the stone,

as pyrites, which causes discolouration and disintegration; others are interesting from their rarity, as beryl, topaz, tourmaline, &c., which are found mostly crystallized out in cavities, notably in the granite of the Mourne Mountains, Ireland; while others may occur in sufficient quantity to impart a distinctive character to the rock. Thus the abundance of tourmaline produces the variety luxillianite; the addition of hornblende to the normal constituents produces the rock hornblende-granite, which is a much tougher rock than the ordinary granite; and if quartz be absent from this, then it passes into syenite.

Granite has approximately the same average chemical composition as rhyolite, which is considered to be but its lava form, obsidian being the glassy form. The actual chemical composition of course varies greatly. The specific gravity of granite is about 2·66, but increases with an increase of the crystalline structure. It appears very probable that granite consolidated deep in the earth, and that its exposure at the surface now is in all cases the result of denudation. It may therefore be of any geological age; but as the older rocks have been the most liable to undergo metamorphism, and have been the longest subjected to denuding agencies, granites are more often exposed in them. However, granites of Tertiary age occur in the Western Isles of Scotland and in the Pyrenees, besides in other localities.

Granite in most cases appears to be of metamorphic origin, being probably the extreme stage in the metamorphism of silicious sediments. Where incipient pastiness has been produced, the rock has many of the characters of an intrusive mass, and veins protrude into the weak portions (Plate, fig. 3) of the surrounding strata. Water cavities in the quartz point to the hydrothermal origin of granite, as also does the fact that the quartz fills the intervening spaces of the other constituents; showing that it was the last to solidify, whereas under ordinary conditions it would be the first, owing to its higher fusing point.

Granite occurs under various conditions; it may occur in large bosses sending veins into the surrounding strata, or it may occur interbedded with gneiss; but the largest masses are found either in the axes of mountain chains or in districts where such chains formerly existed, but which have been removed by denudation. In the Plate (figs. 1, 2, 3, 4) the manner in which granite and granitic rocks occur is shown. In fig. 1 a *boss* of granite at the bottom of the figure sends an irregular *vein* of granite upwards through the killas; this sends off three narrow, almost parallel veins or *dykes* of fine-grained granite (elvan), that cut across the bedding of the killas, and probably were intruded along joints or lines of weakness in the original strata; transverse to these, through the killas and granite boss, quartz strings and lodes have been developed. In fig. 2 tortuous tongue-like *granite veins* are shown intruded in bedded rock; both are cut across by subsequent or newer *porphyry dykes*. In fig. 3 granite veins are shown intruded along joints or breaks; along the main vein there has evidently been a lateral displacement, and some of the adjoining rock has been absorbed into the granite. In fig. 4 a diagrammatic section of the structure of a mountain chain is shown, granite or some granitic rock occupying the axis. Figs. 5 and 6 show the occurrence of greenstone (diorite) similarly to granite in bedded rock; detached portions of the latter are seen in the igneous mass. Granite of metamorphic origin usually becomes gneissose towards its boundaries. In some cases it represents the base or lower portion of volcanic rocks, probably the root of an old volcano.

(2) *Veins* and *dykes* are portions of the originally pasty or molten mass that have been forced into fractures or fissures of adjoining solidified rock from the main mass (boss). Veins as a rule are less regular and more tortuous than dykes; they penetrate the adjoining rock in tongue-like and ramifying masses (see Plate, figs. 1, 2, 3). Besides granite, diorite, diabase, some melaphyres and dolerites occur in veins. Dykes are more regular both in width and direction; if in stratified rocks they cross the bedding, and often occur in parallels of great extension. Admirable examples are the elvans of Cornwall and the greenstone dykes of the north of England. In dykes the central portion is generally more largely crystalline than the sides, which often pass through a finely crystalline structure to an outer vitreous coating.

(3) *Intrusive sheets* are large bodies of the pasty or molten mass that have been injected or intruded between strata, in more or less regular layers; they are practically dykes, conforming for the most part to the stratification; they often, however, break across the bedding and send veins and offshoots into the rocks both above and below (see fig. 7). These sheets mostly connect with dykes or pipes, and through them with the granitic boss or root. As in dykes they are more largely crystalline towards the centre, and the adjoining rock, both above and below the sheet, is indurated or otherwise affected. In the Plate (fig. 7) an intrusive sheet is represented proceeding from an old volcanic neck, and giving off dykes into the strata both above and below; some distance from the neck it becomes split up into three separate sheets, which gradually thin away.

(4) *Necks* are masses of intrusive rock filling old volcanic pipes; they are practically dykes limited in lineal as well as lateral directions; they may be circular, elliptical, or irregular in outcrop and of varying size, but their downward prolongation is generally pipe-like, and more or less at right angles to the bedding of the strata (see fig. 7). The most commonly occurring rocks in necks are, felstone, quartz-porphyry, diabase, porphyrite, dolerite, &c. They sometimes partake of a clastic or fragmental character.

Intrusive rocks usually largely affect the rocks in which they occur. In most cases this is an induration or apparent baking of the portion in the immediate vicinity of the intruded mass. But in the case of bosses, especially those of granite, the alteration or metamorphism is often much more widely extended. Here large regions often show a gneissose or schistose structure, and mineral veins are not uncommon. The origin of these intrusive rocks is a question difficult to decide, but among geologists the opinion is steadily gaining ground that they are the result of intense metamorphic action—the bosses representing the main mass of the altered rock in its original positions, which sent out veins of pasty or more or less fluid material forming dykes, intrusive sheets, necks, &c., and through these connecting with the volcanic rocks at the surface.

INTUITIONS and **INTUITIVE TRUTHS.** Immediate and unreasoned judgments are a fact in human nature. Every one is conscious of being able to make many statements and many judgments without any reasoning or inference. In fact all assertions dependent on memory are of such a character. But the nature of this power of intuition is disputed. On the one side the upholders of the doctrine of innate ideas [see IDEA] assert that there is a large class of our ideas which is born with us as a part of our nature and only wait development. Of such are the axioms of both physical and mathematical sciences. Their opponents declare that these ideas, like all others, are the outcome of experience, but since they are involved in the earliest judgments of infancy, the mind reaches the power of instantaneous swiftness, and therefore of intuition in their regard, at a very early age, and the steps of experience are forgotten. Probably both are wrong and both right; and intuitions are to be explained as certainly all derived originally from experience, but transmitted as beliefs, vague knowledge, or inherited intellectual tendencies from whole generations of ancestors who have slowly accumulated them.

IN'ULIN or **HEL'ENIN**, or **MENYAN'THIN**, a substance resembling starch, obtained from elecampane, *Inula Helenium*, natural order Compositæ. It is also found in chicory, potato, Jerusalem artichoke, sun-flower, in some lichens, as in Iceland moss, *Cetraria Islandica*, and many other plants. It is insoluble in cold water and in alcohol, but soluble in boiling water; the solution does not gelatinize on cooling. It is also soluble in strong sulphuric acid; the solution is precipitated by ammonia. It is also soluble in cuprammonia solution. It gives a white precipitate with infusion of galls. By heating it is completely converted into fermentable sugar. Dilute acids produce the same change. The formula is $C_6H_{10}O_5$. It is unfermentable, and gives a very slight brown colour with iodine. It reduces salts of copper, lead, and silver to the metallic state.

IN'VER is a very frequent prefix to names of places in Scotland and Ireland, but is rarely used separately. It has the same meaning in the Gaelic and Erse as *Aber* in Cymric, the meeting of waters, either of two rivers, or of a river with the sea or a lake. The names are mixed in Scotland in a singular way; the Invers being chiefly, though not solely, in the north-west or Gaelic districts, and the Abers chiefly in the south-east, where the Cymric kingdom of the Picts long existed; and it is known that the same places have borne both names. Inver becomes Inner by assimilation. Aber is unknown in Ireland, and Inver in England.

INVERA'RAY, a royal burgh of Scotland, situated at the mouth of the Aray, which falls into Loch Fyne. It is the capital of Argyleshire, and is a seaport, but the harbour can be entered only by vessels of light draught. It is 67 miles north-west of Glasgow, and 405 miles from London by the Caledonian Railway. The population of the burgh in 1881 was 939; they are chiefly employed in the herring fishery, the town being the head station of the fishery in Argyleshire. There are about 1100 boats, employing 2700 men and boys: the total value of the boats, nets, &c., being about £30,000. About 25,000 barrels of herrings are caught yearly, in addition to large quantities of ling and cod. The town consists of a main street running up at right angles to the bay, facing which there are several residences. It has a parish church embracing Gaelic and English places of worship, a Free church, a United Presbyterian church, and an Episcopalian chapel, a county court-house, post office, with usual departments, and branches of the National and Union banks. An ancient cross in the chief street and a curious conical hill with a tower at its summit are the chief objects of interest. Near the town stands Inveraray Castle, the seat of the Duke of Argyle.

INVERCAR'GILL is the name of a town in South Island, New Zealand, the capital of the province of Southland. It is situated at the mouth of the New Ross River, five days' sail from Melbourne, and 156 miles by sea from Port Chalmers. Several newspapers are published here, and in the town are several banking establishments, two Presbyterian and two Episcopalian churches, hospital, hall of justice, and a fine postal telegraph office. Invercargill is one of the most rising towns in the South Island. It is served by railway in every direction. The district is principally taken up for pastoral purposes; but agriculture is rapidly extending, and is successfully carried on by a large number of settlers. The exports principally comprise wood, grain, and timber, the timber trade especially being extensively followed. The soil generally is very productive; the climate, although variable, is suitable for the growth of all products common to Great Britain. The population is about 5000.

INVERKEITH'ING, a small market-town of Scotland, in the county of Fife, finely situated on rising ground on a bay, which occasionally affords a safe asylum for large vessels lying in the Leith roads. It is 16 miles W.N.W. of Edinburgh by a branch line of the North British Railway, and consists chiefly of one street. Ropemaking, shipbuilding, brickmaking, and tanning are carried on to a small extent, and in the neighbourhood are freestone and whinstone quarries. The harbour admits vessels of 200 tons, and somewhat large quantities of coal are shipped. There is a parish church, a United Presbyterian church, a town-hall, corn-market, and an old cross. There are also some remains of a monastery, and an old palace is shown where Robert III.'s widow is said to have resided. Inverkeithing is a royal burgh. The population in 1881 was 1366.

INVERNESS', the largest county of Scotland, is bounded N. by Ross-shire and the Moray Frith, S. by the shires of Perth and Argyle, E. by those of Nairn, Elgin, Banff, and Aberdeen, and W. by the Atlantic Ocean. The greatest length from N.E. to S.W. is 85 miles, and the greatest width from N.W. to S.E. is nearly 55 miles. The entire county contains about 2,616,498 acres. It comprehends a considerable portion of the Hebrides or Western Isles, including the isles of Skye, Harris, Benbecula, North and South Uist, Barra, &c. The population in 1881 was 90,454.

The county, which is extremely mountainous, is intersected by innumerable lakes and rivers, and is divided into two nearly equal parts by the deep valley usually called the Great Glen of Scotland, which runs from Fort William to Inverness. The Highland character and Gaelic language predominate in it. The low grounds are well cultivated; the lower hills are pastured by sheep or reserved for grouse shooting; and the high grounds are for the most part set apart as deer forests, for which they are well adapted. According to the official agricultural returns there were only 130,000 acres, or not quite a twentieth part of the entire area, under cultivation in 1885. Corn was grown on 40,000 acres (30,000 of which were devoted to oats), and 20,000 acres were green crops. The remainder was either permanent pasture or artificial grasses. There are 50,000 cattle and 700,000 sheep in the county. The sheep are mostly of the black-faced and cross breeds; the cattle of the Skye or cross breeds. A great deal of waste land has been drained and reclaimed, and much ground planted. The fir woods in Glenmore and those of Strathspey, belonging to the Earl of Seafield, are supposed to be more extensive than all the other natural woods in Scotland together. The native woods chiefly consist of oak, fir, birch, ash, mountain ash, elm, hazel, and the Scotch poplar. Those which are planted are larch, spruce fir, silver fir, beech, plane, and fruit trees. Red-deer, roe-deer, grouse, blackgame, ptarmigan, woodcock, partridges, the Alpine and common hare, and other game, are abundant.

The prevailing rocks are of the primary class. Gneiss and mica slate are perhaps the most abundant, but huge masses of granite and trap and porphyritic rocks are met with in the Grampians and the mountains of Glencoe and Ben Nevis. Limestone is found in several districts, and frequently approximates to the nature of marble. Sandstone is also met with in various places in the southern part of the county. Some veins of lead and silver have been discovered; iron ore is also found in small quantities. Everywhere traces of the action of ice during the glacial period are found. The soil is for the most part light and sandy, with a subsoil of gravel or clay. The principal rivers are the Spey, Lochy, Ness, and Beauly, in all of which there are valuable salmon fisheries. The two principal mountains are Ben Nevis and Mealfourvounie. The former, which is separated from the Grampians by the desolate tract called the Moor of Rannoch, is composed of porphyry and granite, and has been determined to be the highest point in Great Britain, being 4406 feet above the level of the sea. It is easily ascended on the western side. Near its summit the snow lies for a great part of

the year. Mealfourvounie rises 2730 feet above the sea-level. The surface of the county is an alternation of mountain ranges and deep shadowy glens. The principal ranges are the Grampians and the Monadhliadh, the latter stretching from the borders of Lochaber to the neighbourhood of Nairn; its highest peaks attain an elevation of 2500 to 3000 feet, and in many parts the ridge forms an immense rugged mass, full 30 miles in breadth, presenting the utmost variety of outline and contrast of colour. The Benalder range, near Loch Ericht, is less lofty but more picturesque.

Glenmore, or the Great Glen of Scotland, as it is sometimes called, which stretches across the county from Fort William to the town of Inverness, is partially covered by three lakes, Loch Lochy, Loch Oich, and Loch Ness, lying nearly in a straight line between the above-mentioned limits. Their aggregate length is 37 miles, and the entire distance between Fort William and Inverness 60 miles. In 1802 Mr. Telford was appointed by the commissioners of the Treasury to make a survey of these lakes and of the adjoining country preparatory to the cutting of a canal. His report was made in the following year, and the works were in full operation in 1805, but the whole line of navigation was not opened till the latter end of the year 1822. It was repaired and reopened in 1847. The expense of constructing the Caledonian Canal, as it is called, was defrayed by government, and amounted to £986,924. That part of the navigation which is not upon the lakes is 22 miles and 1628 yards in length: it is 50 feet wide at the bottom, 110 feet at the surface, and 17 feet deep. Loch Oich is nearly the summit-level of the canal, and its elevation is 94 feet above the level of the sea on the east coast at high water. The canal has not fully answered the expectations of its promoters; for instead of availing themselves of the route, seamen seem to prefer taking the chance of a favourable run round the northern extremity of Scotland. It is, however, extensively employed in summer for the transit of passengers and goods between the Clyde and Inverness; and forms a favourite route for the numerous tourists who annually visit the Highlands.

The scenery of Inverness is exceedingly romantic and highly diversified. Fort William and Fort George, at opposite extremities of the Great Glen, were originally erected as strongholds to overawe the Highlanders. The scenery in the neighbourhood of the former is very fine, Ben Nevis towering in majesty in the east.

INVERNESS, a seaport town and royal burgh, the capital of the above county, and the principal town of the Highlands, is beautifully situated near the extremity of the Moray Frith and the eastern entrance of the Caledonian Canal, 596 miles by railway from London. The town is of considerable size and well built; the houses are lofty, and many of them elegant. The streets are well paved with granite, the drainage is good, and there is an ample supply of water. The population in 1881 was 17,365.

The main streets are built on the eastern bank of the river Ness, which is traversed by a suspension bridge, two foot suspension bridges, and by a wooden bridge at the north end of the town. The principal buildings are—the Cathedral of St. Andrews, a handsome edifice in the Decorated Gothic style; four Established churches, five Free churches, and United Presbyterian, Independent, Baptist, Wesleyan Methodist, and Roman Catholic places of worship; the castle, a modern building situated on an eminence overlooking the Ness, and occupied as county hall, court-house, and jail; handsome new municipal buildings, opened by the Duke of Edinburgh in 1882; the exchange, in the centre of which is the Forbes Memorial Fountain, under which the famous "Clach-na-cuddin," or "Stone of Tubs," is placed—so called from the traditional fact that on this stone women rested their water-buckets when conveying to their homes water from the river, about 150 yards distant (the stone has been carefully preserved since the battle of Harlaw, fought in 1411); a working men's club, the head office of the Caledonian Bank, Faraline Park Institution, formed by Dr. Bell of Madras; royal endowed academy, infirmary, and reformatory. Inverness is the headquarters of the Northern Meeting established for the promotion of Highland sports, &c., which have a fine suite of rooms and spacious grounds. There is a cemetery near the town, and also the Inverness district lunatic asylum, capable of containing 350 inmates. The climate is much milder than might be supposed from the northern position of the town, the mean annual temperature being about 46°. The chief articles imported are coal, wine, grain, and tar; oats, timber, wool, sheep, and fish are exported. A great gathering of West Highland farmers and southern buyers is held about the middle of July in each year, when a vast quantity of wool taken from sample and amount of stock on the good faith of the seller changes hands. The port admits vessels of 400 tons to the harbour, and larger craft at Kessock Ferry and the Caledonian Canal. The number of vessels registered as belonging to the port amount to about 100, of 9000 tons burden. The entries and clearances average 2500 (310,000 tons) per annum. Regular traders ply to London, Leith, and Aberdeen; and by means of the Caledonian Canal to Glasgow, Liverpool, and Ireland. Inverness is the terminus of a system of railways, now absorbed by the Highland Railway, which connects it with Sutherlandshire, Ross-shire, Aberdeen, Perth, and the south. Since the introduction of these lines the town has been much visited by tourists and greatly improved by the building of villas and the erection of several handsome new streets. Its environs, well cultivated and beautifully wooded, are almost surrounded by mountains and hills of various heights, forming altogether a most picturesque and interesting landscape. The islands of the Ness, within a mile of the town, have been formed into a fine promenade, connected with the banks by elegant suspension bridges. The municipality consists of a provost, four bailies, a dean of guild, a treasurer, and fourteen councillors.

Though of great antiquity the origin of Inverness is unknown; but a castle occupied an eminence to the south-east in the eleventh century, in which, according to tradition, King Duncan was murdered. English or Lowland Scotch is now the ordinary language of the inhabitants; but Gaelic is known to most of the working population, and is alone spoken in some of the secluded parts of the county. About 5 miles east of Inverness lies Culloden Moor, where the army of Prince Charles was totally defeated in about half an hour in 1746.

INVERSE, INVER'SION. Any two operations of algebra are said to be inverse when one of them undoes, so to speak, the effect of the other; so that, if both be successively performed upon the same quantity, the result is that quantity itself. For instance, the operations implied in $(1+x)^2$ and $\sqrt{(x-1)}$ are inverse to one another, for

$$1+[\sqrt{(x-1)}]^2=x,\ \sqrt{(1+x)^2}-1=x.$$

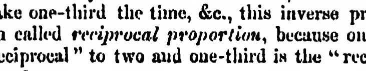
Here, to prove the inverseness of the quantities given for each operation in the one equation we take the inverse operation in the other; we add 1 to the one and subtract 1 from the other; and we take the square power of the one bracketed quantity and the square root of the other bracketed quantity. We need do no more than name addition and subtraction, multiplication and division, involution and evolution, that is, raising of powers and extraction of roots, as well-known pairs of inverse operations.

INVERSE (or RECIP'ROCAL) PROPORTION. In arithmetic, the so-called "rule of three" [see PROPORTION] gives the practical method of discovering the fourth term of a series of four when three only are given. For four quantities to be in proportion they must be arrange-

able in two pairs, each pair having exactly the same ratio between its terms. Thus 2, 4, 6, 12 are in proportion, because 2 is to 4 as 6 is to 12, each first term being the half of the second term. One property of proportions is that the outside terms multiplied together equal the inside terms multiplied together; in our example $2\times12=24=4\times6$. It is plain at once that if we have a question thus stated: "If two bricklayers can build 4 feet of wall in an hour, how much could six bricklayers build?" we state the four terms $2 : 4 :: 6 : x$, and $\frac{4\times6}{2}$ gives us our answer, 12. But suppose we have the same quantities in this form:—"If it takes two bricklayers twelve days to build a certain length of wall, how many days would it take six bricklayers to build the same?" then it would be manifestly absurd to expect our answer for the statement $2 : 12 :: 6 : x$, for this would make $x=\frac{12\times6}{2}=36$, and we should have the absurdity that six men took more time than two men to do the same work. When, therefore, the form of the question indicates that the answer is to diminish as the third term increases, the question is held to be in *inverse proportion*, because the terms are inverted, and the larger term is set before the smaller in the first ratio in order that the like order shall appear in the second ratio. We should state the question therefore in inverted form, thus $12 : 2 :: 6 : x$, whence $x=\frac{2\times6}{12}=1$, and the answer is one day. Now since two men take one-half the time to do the work done by one man in an hour, and since three men take one-third the time, &c., this inverse proportion is often called *reciprocal proportion*, because one-half is the "reciprocal" to two and one-third is the "reciprocal" to three, &c.

INVER'SION, in music, is a change in the relative position of two sounds, or of the several notes of a chord, whereby the note which was at the bottom is now placed at the top. Thus C D, an interval of a Second, becomes by inversion (D C) a Seventh. [See INTERVAL.] The process is not quite so simple in the case of chords, because chords may have three, four, five, six, or seven notes, each a Third above its predecessor, according as they are Common Chords, Sevenths, Ninths, Elevenths, or Thirteenths. The *first* inversion of a chord is when its bass (root) is taken in an upper part, the second note of the chord (the Third to the root) now becoming the bass. The *second* inversion of a chord is founded on the first, for the bass-note of the first inversion is now used in some upper part as well as the original root; the chord therefore stands in its second inversion upon the Fifth to the Root. The Common Chord, consisting of three notes (the Root, its Third, and its Fifth) has therefore only two inversions, and generally *every chord has as many inversions as there are notes in the chord, less one.*

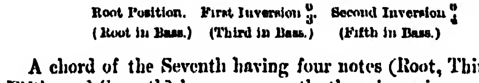
Common Chord of C Major and Inversions.



Root Position. First Inversion $^6_3$. Second Inversion $^6_4$
(Root in Bass.) (Third in Bass.) (Fifth in Bass.)

A chord of the Seventh having four notes (Root, Third, Fifth, and Seventh) has consequently three inversions, and a chord of the Ninth having five notes (Root, Third, Fifth, Seventh, Ninth) has consequently four inversions, and so on.

Chord of the (Minor) Ninth and Inversions (Key of C).



Root Position. First Inv. Second Inv. Third Inv. Fourth Inv.

Here it will be observed that the root of the Ninth is not sounded except in the root-position, which is a rule governing the inversions of all forms of this chord. In fact, the inversions of Ninths, Elevenths, and Thirteenths are subject to many rules in practice, and not all the inversions of these chords are available in harmony. For instance, if we had taken the chord of the major Ninth for our illustration with A natural instead of A flat for its top note, the second and third inversions would have been impossible to use in the positions there given, while the fourth inversion would have been altogether unavailable, as a major Ninth must always be sounded above the Third of the same chord—that is, in the case of a major Ninth upon G, A♮, the Ninth, must always be written in the harmony above B, the Third. These various rules are all given in the articles upon the several chords. See COMMON CHORD, SEVENTH, NINTH, &c.

INVER'SION OF STRA'TA, a term used in geology when a series of beds have undergone such extreme plication as to be turned over completely on themselves, so that the beds geologically older are placed uppermost. Numerous examples occur in mountain ranges where the strata are much crumpled and folded, as the Alps. In the British Isles examples of inversion on a smaller scale occur in the Palæozoic rocks.

INVER'TEBRATE ANIMALS are all animals which do not belong to the subkingdom VERTEBRATA. The division of the animal kingdom into Vertebrata and Invertebrata is purely a matter of convenience. Beyond the negative character of not belonging to the Vertebrata, the Invertebrates have nothing in common.

INVERU'RY, a royal burgh of Scotland, in the county and 16 miles north-west of Aberdeen, and 559 miles from London by the Great North of Scotland Railway. It is situated on the left or north bank of the Don, in the angle formed by the junction of the Urie. There is a substantial modern bridge over each stream. The town consists of a long straggling street. The parish church and the Free church are both handsome buildings. There are also an Episcopalian church, a Congregational church, a Roman Catholic church, a Wesleyan chapel; and several banks and insurance agencies. The town has a considerable general trade, and a tannery, a brewery, and meal and paper mills. A handsome town-hall was erected in 1863. There is a curious mound, called the Bass of Inverurie, at the southern end of the town, which has several local traditions attaching to it. The population of the burgh in 1881 was 2931. It gives the title of baron to the Earl of Kintore, whose seat, Keith Hall, is near the town.

INVES'TITURE. The act of giving possession under the feudal system, and especially as regards ecclesiastical benefices. The Latin word *vestire* has nothing to do with *vestment* (according to a widespread popular belief), it is simply to put in possession; and a person was invested with an estate by the presentation of a banner or a bough more often than by that of a vesture. Even ecclesiastical offices were conferred for the most part by the presentation of a ring or a pastoral staff. In the case of archbishops the *pallium*, it is true, was added, but it is the exception and not the rule. Up till the time of Hildebrand the popes did not make much stir about investiture. The spiritual peers received their appointment and paid their homage for the most part much as the lay peers did. But the future Gregory VII. could not bring himself to acquiesce in so manifest a treason to the rights of the church, and by his influence this thorny question was raised in 1068, when a synod held at Rome forbade any priest to accept investiture at the hands of a layman. The logical result, as Hildebrand well knew, was the freedom of the church from state control, if this all-important point of form could be gained, as well as what was not less desirable, the immense increase of power which the hierarchy would gain over the entire church. The discipline of the church and its

supremacy, such were the prizes to result from a victory on the question of investiture, and the stake was worth the contest. In five years' time the first open contest came in the form of a popular rising at Milan against the bishop, nominated as heretofore by the emperor. When Gregory VII. (Hildebrand) came to the throne a most peremptory decree was issued by the council which he called in February, 1075, deposing the temporizing ecclesiastics who submitted to feudal investitures, and excommunicating not only them but the peers who invested them. The long conflict which raged between the papacy and the empire is elsewhere described [see GREGORY VII., HENRY IV. &c.]

The following are among the more important remaining points. The formal restatement of the prohibition of clerical investiture at lay hands by Urban II. in 1090. The yielding of the point entirely by the Emperor Henry V. in his treaty with Pope Paschal II., made in the porch of St. Peter's, in 1111, the pope being helpless in Henry's hands, and the right being given up only in return for the surrender of *all* the territorial possessions held as fiefs of the empire by ecclesiastics from the time of Charles the Great. The lands being gone the investiture quarrel became empty words. The church retained the patrimony of St. Peter alone. The emperor refused three days later, 12th February, 1111, to ratify the treaty, and arrested Paschal II., who in consequence declined to proceed with his coronation. This tumult took place in St. Peter's itself, and was followed by bloody street fighting. After a long imprisonment Paschal, moved by the sight of the undoubtedly terrible miseries suffered in the Roman territory under the German invasion, yielded the whole question, and the treaty was signed, conceding the imperial investiture to Henry, at Ponte Mommolo, 12th April, 1111. The pope was escorted back to Rome, still prisoner, and crowned the emperor in St. Peter's with closed doors, and he was then set free, and Henry returned to Germany. Instantly Paschal was assailed by the clamour of the whole Roman hierarchy. In vain he pointed to the oath he had sworn in the Host—"As this part of the living body of the Lord is severed from the rest, so let him of us be severed from the Church of Christ who shall violate this treaty." In vain he offered to resign his chair, the constant reproaches of the cardinals and the clergy overpowered him, and in 26th October, 1111, he wrote to the Archbishop of Vienne that the treaty having been extorted by compulsion was null and void. At the Council of the Lateran in March, 1112, this view was taken by all with acclamation and the compact solemnly annulled. Lay investiture was decreed to be heresy, and Henry excommunicated at the Council of Vienne, October, 1112. Again clerical investiture was claimed at the Council of the Lateran in March, 1116. The pope was again and again accused of heresy on account of this fatal treaty. In this Lateran Council of 1116, Bruno (afterwards St. Bruno) called him a heretic to his face. The pope bore these insults with great dignity. Passing over the rival popes Gelasius (church-pope) and Maurice (emperor's pope) the next undisputed pope, Calixtus II., renewed negotiations with Henry V. at the Council of Rheims in 1119, but each suspected the other of treachery and they fell through. Calixtus then proceeded formally to excommunicate Henry once more in presence of the whole council. Eventually, however, in 1122, the Emperor Henry V. and the Pope Calixtus II. agreed to the concordat of Worms; the ring and staff were allowed to be given by the pope, the temporalities by the emperor. The freedom of election was granted to the church by the emperor, but in return it was agreed that the elections should take place in the presence of the sovereign or of his officers. The emperors lost a very ancient prerogative in surrendering the elections, but they regained their feudal sovereignty. Yet, on the whole, the church must be admitted to have won the victory.

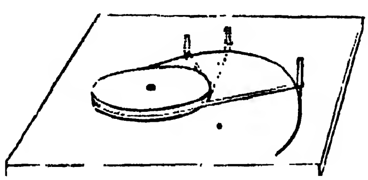
In England the contest arose between Henry I. of England and Archbishop Anselm, out of Henry's claim to military service from spiritual fiefs as well as from lay, and hence his insistance on the right of investiture. In August, 1106, a compromise was effected, and Henry yielded to the pope the ecclesiastical investiture by staff and ring, but retained the right not only of lay investiture as regards the temporalities of the sees, &c., but also the right of nominating the persons to the vacancies, who thereupon presented themselves to their ecclesiastical superiors for the ecclesiastical investiture. In France the question was solved as much on the church side as in England it was on the royal side. The difference lay in the English and more still the German prelates being persons of greater positions in the state than in France. In Spain the astuteness of the monarchs led them to admit at once the pretensions of Rome, and the papacy, gratified by this acquiescence, readily granted far better terms to Spain than any of the more resolute kingdoms could ever obtain.

INVOCA'TION OF SAINTS AND ANGELS. This practice is very widely diffused throughout the Christian world, but it is one that is generally rejected by the Protestant churches. It prevails in the Roman Catholic, Greek, Russo-Greek, and other Eastern churches, and the usage dates from the early centuries of the Christian era. It was certainly introduced before the time of Origen, who refers to it in his writings, and during the fourth and fifth centuries it became well-nigh universal throughout the church. In support of this doctrine of the intercessory relations of the angels and saints to men Catholic writers quote Apoc. v. 8; viii. 3; Job xxiii. 23; v. 1; Tobias xii. 11; Luke xix. 10; and other passages of Scripture. At the period of the Reformation, however, the honour paid to the Virgin Mary and the invocation of saints and angels was fiercely assailed as unscriptural and idolatrous by the Protestant leaders, and the subject formed one of the most fruitful of the various themes of controversy between the opposing parties. At the Council of Trent it was decided as to this subject that while supreme worship (*latreia*) could be offered to God alone, a lower form of worship (*douleia*) might rightly be given to saints and angels, and the highest form of the latter worship (*hyperdouleia*) was due to the Virgin Mary. It was further pointed out that the saints and the Virgin are invoked merely as being intercessors with God, and that it is the benefit of their prayers that is asked, and not that they will confer direct blessings themselves. It is this form of the doctrine that is maintained and defended by Roman Catholic apologists, and which is taught in the Catholic popular catechisms, based on that issued by order of the Council of Trent. The practice has been almost totally rejected by Protestants since the period of the Reformation, and though slight attempts have been made by some sections of the Church of England to reintroduce it their efforts have not met with much success.

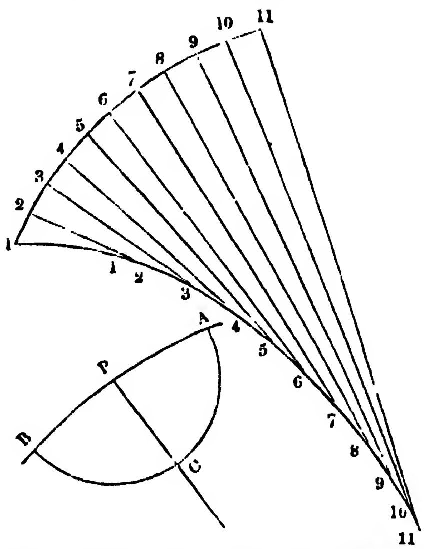
IN'VOICE, a priced account of goods sent with the goods on delivery or closely afterwards. It contains a record of the alleged quantity of goods, their price, charges upon them of any kind, and any other necessary particulars. Payment is not necessarily expected upon presentation of an invoice; hence it differs vitally from a bill or statement of account, which merely sums up the amount of the invoice or invoices sent in since the last bill that was paid, and which is presented with a view to the settlement of the account. Since the invoice is often *sent* with the goods the temptation is strong to derive it from the French *envoi*, a sending or message; and this has the great authority of Professor Skeat in his scholarly "Etymological Dictionary" of English. Nevertheless seeing the large indebtedness of our commerce to Italian for its terms, it seems more likely that invoice is the Italian "letter of advice," *Lettera d'avviso*, and that the *n* and *o* have slipped in as a piece of folk-etymology, likening it to *envoi*, when its real origin had become obscure.

INVOL'UNTARY MUSCLES are those over which the will (Lat. *voluntas*) has no power. The fibres of these muscles are plain or unstriped (*non-striated*); and the muscles are for the most part not attached to bony levers (arm, leg, ribs, &c.), but enter into the formation of such hollow parts as the heart, bladder, intestines, &c., and their usual function is to compress the part upon a certain physical stimulus. Frequently they have a vermicular or peristaltic action, as with the intestines, and to a less degree the bladder and the stomach. See also MUSCLE.

IN'VOLUTE and **EV'OLUTE** (the curve unrolled and the curve from which it is unrolled), a name given to two curves so formed and placed that, supposing the second to be cut out from solid matter, the first can be formed by fastening one end of a thread upon a point in the second, attaching a pencil to the other end, and moving the pencil so that the thread may either gradually enwrap or be unwrapped from the curve to which it is fastened. Thus the pencil in the diagram is describing the involute of a circle, or the curve of which the circle is the evolute. But the evolute of a circle is evidently a



point. Every curve has one evolute and an infinite number of involutes. The proper name for curves described from the same evolute is *parallel curves*, since they have the fundamental property of parallel lines: for they never meet, though (if they admit of it) ever so far produced; a straight line perpendicular to one is always perpendicular to the other, and the part of the perpendicular intercepted



is always of the same length. When arcs of parallel curves are required to be laid down, the most commodious method of proceeding is to construct the evolute of one of the arcs approximately, as follows. On the arc draw tangents at moderately small distances, and draw perpendiculars to those tangents. The parts of the tangents cut off from each by its neighbours will together give the arc of the evolute near enough for all purposes. And it may be well to notice that it will be a sufficiently accurate method of drawing the perpendicular to the tangent at a point P, if we take a small circle whose centre is P, bisect the arc A C B in C, and join and produce P C.

The angular error thus committed is only a small portion of the angle made by the tangents at P and A.

IN'VOLUTION and **EV'OLUTION** are algebraical terms, the former signifying the raising of powers and the latter the extraction of roots. When any number is multiplied by itself, we get its square or second power; and if we multiply this product by the number again, we get the cube or third power, and so on. The inverse process, called evolution, enables us to find a particular root of a number—say, the fourth, or that number which, being multiplied into unity four times, the product will be the number originally given. Both subjects are treated of in every algebraical text-book. Articles are given in this work upon the simplest cases, those of the SQUARE and the CUBE.

IO, in ancient Greek mythology, a daughter of Inachos, king of Argos, whose beauty excited the admiration of Zeus and the jealousy of Hêra. Zeus, to protect his mistress from Hêra's vengeance, transformed her into a white heifer; but the queen of heaven discovered the stratagem, seized the hated heifer, and intrusted her to the care of the hundred-eyed giant Argos Panoptes. Io was freed and Argos was slain by Hermês, thence called Argeiphontês, or the slayer of Argos. Hêra then sent a gadfly which stung the heifer into madness, and drove her wandering over the earth; furnishing Æschylus with a subject for his tragedy of "Prometheus Bound." Stung to madness by the gadfly poor Io leapt into the sea and swam across to Asia, whence the strait she crossed was called the "Ox-ford" or in Greek *Bos-poros*, our Bosphorus. She wandered on, always stung by her tormentor, till she reached Egypt. There she found rest on the banks of the Nile. Zeus restored her to her human shape and she bore him a son, Epaphos. The reference to Egypt seems to be derived from an assumed connection of Io with the Egyptian Isis, possibly an invention of later time. The wandering of the moon in the heavens among the stars with their hundred eyes, and her shape, at first horned like a cow, then swelling to the full, explain the main points of the myth. It was one of the most favourite subjects of the Greek poets, painters, and sculptors.

Io, the small planet, one of the ASTEROIDS, was discovered by Peters, 19th September, 1865.

IODACET'IC ACID, an acid obtained by the action of potassium iodide on bromacetate of ethyl. It crystallizes in rhombohedral plates, melting at 82° C. (180° Fahr.) The formula is $C_2H_3IO_2$. Oxide of silver converts it into glycollic acid ($C_2H_4O_3$). It forms a number of crystalline salts called iodacetates, mostly soluble in water. Di-iodacetic acid ($C_2H_2I_2O_2$) is obtained in a similar manner from dibromacetate of ethyl, in yellow crystals slightly soluble in water, and forming yellow crystalline salts called di-iodacetates. The ethers of these acids are also known; both are oily compounds insoluble in water.

I'ODAL, a compound bearing the same relation to iodine that chloral does to chlorine, and converted by potash into iodoform. The formula is C_2HI_3O. It is an oily liquid, boiling at 25° C. (77° Fahr.)

I'ODINE, an elementary body discovered by M. Courtois in 1812. The name is derived from the Greek word *ion* (violet), in allusion to the colour of its vapour. It is an important constituent in sea-water, but is present in such minute traces that ordinary analysis fails to detect it, whereas bromine is easily detected in sea-water. Recent researches have shown it to exist in the proportion of one part in 280,000,000 parts. Marine animals, and especially marine plants, eliminate it and contain it in much larger proportion. Of the Algæ the Laminaria and Fuci yield

the most; the gelatinous species, such as Chondrus and Gelideum, do not contain it. The following proportions, found by Stanford in some marine animals and plants, will give an idea of the quantities contained:—

Cod fish (fresh), per cent. iodine,	. .	·00016
Herring " "	. .	·00065
Oysters " "	. .	·00004
Sponge, Turkish, "	. .	·20000
Laminaria digita, dry, "	. .	·45350
" saccharina, "	. .	·27940
Fucus serratus, "	. .	·08560
" vesiculosus, "	. .	·02970

It is also found in minute traces in some mineral waters and saline springs, notably the English Woodal Spa, the water of which contains 5·21 parts per million. It is also found in several minerals in combination with silver and mercury, and some of the native phosphates of lime, and also in the caliche of Peru and Chili, or Chilian saltpetre (nitrate of soda). It was first manufactured in quantity in 1841 in Glasgow from kelp, and for upwards of thirty years this remained the only commercial source. Kelp is simply the ash of various seaweeds, generally the Laminaria or Fuci, burned into a rough slag at a temperature high enough to melt the potash salts; in this process more than half the iodine is lost. The shores of Brittany in France, the west of Ireland, and the outer Hebrides, are the only seats of this manufacture. [See KELP.] This product is lixiviated with water, and the potash salts crystallized out as chloride and sulphate. The mother liquor is treated with oil of vitriol, some sulphur is deposited from the sulphides and sulphites present, and separated; the liquor is then distilled with peroxide of manganese, and the iodine sublimed into udells made of earthenware. This is probably the only manufacturing process in which the old alchemist's udell is still employed. A large quantity of iodine is now produced from the mother liquor of the caliche, after the nitrate of soda has been crystallized out; the iodine exists in this liquor as an iodate of sodium, and is reduced and precipitated by sulphurous acid, made on the spot by burning sulphur. The present annual production of iodine is about 6000 cwts., of which about five-sixths are now made in Chili or Peru.

Iodine crystallizes on sublimation in fine rhomboidal plates, or in octohedrons, with a grayish-black metallic lustre; the thinnest plates are transparent and red by transmitted light. It melts at 107° C. (225° Fahr.) and boils at 180° C. (356° Fahr.), subliming unchanged. The vapour has a splendid violet colour, so deep that a stratum 4 inches thick is impervious to light; this vapour is extremely heavy, having a specific gravity of 8·716. Iodine volatilizes in the cold when exposed to the air, the odour resembling that of chlorine. The symbol is I, the atomic weight 127. It is very slightly soluble in water, but dissolves readily in alcohol and ether, forming brown liquids decomposed by water, and in soluble iodides forming colourless solutions unaltered by addition of water. It is also very soluble in bisulphide of carbon and benzine, forming rich violet liquids. It acts as a bleaching agent, and generally resembles chlorine and bromine, but is less energetic, and is easily removed from its compounds by either of these elements. It forms a characteristic intense violet colour with starch, and this reaction affords an extremely delicate test for the presence of free iodine in any solution. Bisulphide of carbon is an equally delicate means of detecting it, with the additional advantage of removing it entirely from solution. It is employed therefore as a test for starch in the examination of organic bodies, and is much used in the laboratory. It is largely employed in medicine for the treatment of goitre and the reduction of glandular swellings; and in the form of iodide of potassium, for internal use as a strong alterative. Burnt sponge (*Spongia usta*) was long used in medicine before its properties were known to be due to the presence of iodine. It is also much used in photography, in the daguerreotype, collodion, albumen, and gelatine processes; also in the manufacture of some of the aniline colours, especially that known as Hoffmann's green.

With chlorine it forms two principal chlorides, the protochloride (ICl) and the trichloride (ICl_3); the former is a brown oily liquid, and the latter is an orange-yellow crystalline body. Two somewhat similar compounds with bromine are also known.

With hydrogen it forms an important acid known as iodhydric or hydriodic acid (HI), a colourless gas which is obtained by treating iodine and iodide of potassium with phosphorus in the presence of water. It can be obtained in aqueous solution by passing the gas into water, by acting on iodine in the presence of water with sulphuretted hydrogen, or by decomposing iodide of barium by sulphuric acid. Hydriodic acid gas fumes strongly in moist air, resembling hydrochloric acid gas. The specific gravity is 4·4429. It is liquefied by pressure, and solidifies at −51° C. The aqueous acid contains 60 per cent. of HI. With bases it forms a number of important salts known as hydriodates or iodides. Some of these are obtained by direct union of the elements, as mercury, potassium, sodium; in the two latter the action is very violent. Most of the iodides are very stable salts, and not readily decomposed. Those of the alkalies and alkaline earths are soluble. Some of the metallic iodides present beautiful colours, as mercury scarlet, and lead yellow. Some of the organic iodides, especially the iodide of ethyl (C_2H_5I), are important agents in organic researches. Many of the iodides are used in medicine, as those of potassium, sodium, mercury, lead; and more are employed in photography, as cadmium, zinc, and magnesium.

With oxygen iodine forms two important acids, iodic acid (HIO_3) and periodic acid (HIO_4). Iodic acid is obtained by oxidizing iodine by nitric acid. It crystallizes in anhydrous six-sided tables; it is very soluble in water, and slightly so in alcohol. Sulphurous acid and other reducing agents convert it into hydriodic acid, and this acid in the presence of iodic acid gives rise to free iodine, a reaction which enables the presence of an iodate to be easily detected. Iodic acid forms a large series of salts, all insoluble except the iodates of the alkalies.

Periodic acid is obtained by the action of chlorine on iodate of sodium in the presence of carbonate of soda. It crystallizes in oblique rhombic prisms (H_5IO_6), which deliquesce, leaving periodic anhydride (I_2O_7), which when heated gives off oxygen and becomes iodic anhydride (I_2O_5). It is very soluble in water, and also in alcohol and ether, the solutions gradually becoming decomposed into iodic acid. It forms a number of salts called periodates, mostly insoluble in water, and all easily decomposed.

With nitrogen iodine forms a very explosive substance known as iodide of nitrogen, or iodamide (NI_3); it is a brownish-black powder, obtained by digesting iodine in solution of ammonia; the slightest friction or the least elevation of temperature when dry is sufficient to explode it with great violence and a flash of violet-coloured light; the principal product of the explosion is nitrogen gas.

Medicinal Properties of Iodine.—By itself this drug is not suitable for internal administration, but in the form of liniment, tincture, and ointment it is largely used as an external irritant. The liniment painted on the skin in front of the chest under each collar bone will often ease the cough and lessen the expectoration in consumption. The use of iodine externally combined with the administration of it in the form of iodide of potassium, a combination of iodine with potash, is the best known method of treatment for goitre, bronchocele, or Derbyshire neck. Iodide of potassium is a medicine of great value in the treatment of

many old long-standing diseases. Chronic rheumatism, especially that form which is most painful at night, the later stages of syphilis, when the bones have become affected and nodes have formed upon them, and chronic lead or mercurial poisoning are all advantageously treated by means of iodide of potassium. This drug has a remarkable power in expelling lead from the system, and its active properties become manifest in this direction almost as soon as it is used. Iodide of iron has been found very serviceable in scrofulous affections of the glandular system, and the inhalation of the vapour of iodine mixed with the steam from hot water is useful in many affections of the air passages. It may be observed here that some constitutions are peculiarly susceptible to the influence of this drug in any of its forms, and its use causes pain in the head, smarting in the eyes, and a constant watery discharge from the nose, a condition known as iodism, and one which indicates that the medicine is unsuitable for the patient.

IO'DOFORM is a yellow crystalline substance with a peculiar saffron-like odour. It is insoluble in water, but very soluble in alcohol, ether, and oils. It melts at 118° C. (298° Fahr.) and sublimes but with partial decomposition. The formula is CHI_3. It bears the same relation to iodine that chloroform does to chlorine. This substance is a powerful antiseptic, and is much used in medicine. Although it contains 90 per cent. of iodine, it is not irritant either internally or externally. It has been largely employed lately as an antiseptic in dressing wounds.

IOKAS'TE or **IOKAS'TA** (Latin *Jocasta*) was the mother of Oidipous (Latin *Œdipus*), whom unknowing she married, believing her son to have perished in infancy. On discovering the involuntary crime she slew herself. See OIDIPOUS.

IOLA'OS, in the Greek mythology, was the son of the half-brother of Herakles and his comrade in some of his greatest expeditions. He rendered such help in the slaying of the Hydra that Eurystheus declared this labour to be unlawfully accomplished. Iolaos was the first winner at the Olympic games, instituted by Herakles, according to the legend. He led a Greek emigration to Sardinia after the death of his uncle and master, and the leading tribe of Sardinia derived its origin from him and his followers. The town on the west coast is called *Iliola* to this day. When the children of Herakles were in dire straits, Iolaos besought the infernal gods for permission to revisit the earth. This unusual favour was granted, and he slew Eurystheus, his uncle's tyrannical oppressor, in the contests into which he plunged. He then returned to Hades.

IO'LE, a princess beloved of Herakles, whose attachment for Iole plunged Deianeira his wife into jealousy, and brought about the death of the hero. See HERAKLES.

I'ON was the mythical ancestor of the Ionians, a people of ancient Greece. His father was the god Apollo, his mother was Kreousa (*Creusa*), wife of Xouthos (Lat. *Xuthus*), king of Athens, and afterwards of Aigialos in Peloponnêsos. Apollo visited Kreousa in a cave below the Akropolis; thither also went Kreousa with her infant son, hoping to gain for him the protection of her god-lover. But Apollo appeared not, yet when she left the child there he came and conveyed it to his temple at Delphi, where he grew up as the youth Iôn among the priestesses. Years after the childless Xouthos came with Kreousa to consult the oracle, and was told that the first youth he met outside the temple would be his son. Meeting Iôn he was overjoyed, and confessed to Kreousa that certain passages in his youth might explain this mystery. Kreousa, angry at the confession, sought to poison Iôn; but he, piously pouring out a libation, discovered the trap, since a pigeon which drank of the liquid as it lay upon the ground died instantly. Horrified, he rushed upon the would-be murderess, but the priestess, inspired, interfered and made known mother and son to each other. Xouthos received Iôn, believing him still to be his own son; Kreousa kept her secret. It is very difficult to understand how the ancients were not revolted by the play of Euripides, which closely follows this tale. It was a celebrated myth in antiquity. Iôn became afterwards king of Athens, and his four sons gave the names to the four Attic tribes.

ION was also the name of a celebrated Greek early tragic poet, friend of Æschylus. We have only several titles, a few fragments, and many laudatory criticisms of the work of Iôn which have come down to us.

IO'NA, also known by the names of *Icolmkill* and *Hy*, or *I*, is one of the Hebrides belonging to Argyleshire. It is situated on the western side of the Isle of Mull, from which it is separated by a narrow channel called the Sound of I. Its length is 3 miles, and at its widest part it is about 1½ miles in breadth. The general aspect of the island is rugged and mountainous, and the surface for the most part consists of moor and bog, occasionally varied by a patch of green pasture. The highest point is Dun-ii, 330 feet. It is one of the trap islands of the western coast, being composed chiefly of basaltic and trappean rocks, which frequently collect in grand columnar masses, and attain a considerable elevation.

The soil is naturally so very fertile that it was regarded as miraculous in the dark ages. Barley sown in the middle of June is ready for the sickle in August. The area is estimated at 2000 acres, of which about one-fourth is under cultivation. There is only one village, Baile Mor, at which steamers from Oban call during the summer. A church and manse have been erected by government grant, and there is also a Free church and school. A small and comfortable inn, erected for the accommodation of tourists by the Duke of Argyle, the present proprietor was opened in 1864. The population of the island in 1881 was 243.

A religious establishment was founded on the island by Columba, a native of Ireland, about the year 563. This was an establishment of Culdees, not subjected to vows, but governed by a code of laws formed by Columba; and it so continued for several centuries, with the highest reputation, not only for sanctity, but for learning. The remains of forty-eight Scottish kings, four Irish kings, and eight Norwegian kings were interred there. For about 200 years it was a bishopric under the kings of Norway. When the papal power was established in Iona, the monastery became a Benedictine abbey. In 1507 the abbey of Iona was annexed to the diocese of the Bishop of the Isles. The revenues of the monastic institution were united to the see of Argyle, and upon the abolition of Episcopacy they became the property of the Duke of Argyle. This island is now chiefly interesting on account of its numerous architectural and other antiquities, a full account of which is given in Dr. Macculloch's "Highlands and Western Islands of Scotland." See also "Iona," by the Duke of Argyll (London, 1870); and Skene's "Celtic Scotland" (Edinburgh, 1877). The principal remains are parts of the cathedral church of St. Mary, the nunnery, and two ancient crosses. The cathedral dates from early in the thirteenth century. A series of restorations of the abbey and other interesting remains were carried out at the Duke of Argyle's expense from 1874 to 1876.

IO'NIA and **IO'NIANS.** The Ionians were a people belonging to the Hellenic race. Herodotus (viii. 44) says that the Athenians were Pelasgoi, and that they took the name of Ionians from Iôn, the son of Xouthos. The name only occurs once in the Iliad, and under the form Iaones. The Ionians at some unknown early period occupied the northern part of the Peloponnêsos, along the Corinthian Gulf, and their country was called Ionia. When the Dorians invaded the Peloponnêsos, about B.C. 1100, the Achaioi (Achæans) took refuge in Ionia, which from that time was called Achaia, and the Ionians under Nêleus, father of the Nestor who

figures so largely in the Iliad, emigrated to Attica, but this emigration was probably gradual. From Attica there was a great emigration of Ionians and others under the sons of Kodros, the last king of Athens, which is called the great Ionian emigration (B.C. 1044); but there may have been various emigrations at different times. The Ionians established colonies in most of the Cyclades, such as Naxos, Andros, Paros, and Delos, and also in Eubœa. The emigrants who proceeded to the coast of Asia, under their leader Nêleus, took Milêtos, which was then inhabited by the Karians. They also took other towns on the same coast, which, with the islands of Chios and Samos, ultimately formed the confederation of the twelve cities of Ionia. These famous twelve cities were—Phokaia, the most northerly, Klazomenai, Chios, Euthrai, Teos, Lebedos, Kolophôn, Ephesus (Ephesos), Samos, in Lydia; and Priênê, Muous, and Milêtos, the most southerly, in Karia. Smyrna being seized by Kolophônian exiles, was added to the confederation about 700 B.C.

This confederation was united by a common religious worship and the celebration of a periodical festival. The place of assembly was the Panionion, at the foot of Mount Mukalê, where a temple, built on neutral ground, was dedicated to Poseidôn. We have no materials for a history of these cities of Ionia as a political community, and no reason for supposing that their political union came near the modern notion of a federation.

Asiatic Ionia was a narrow strip of sea-shore which extended from the Gulf of Kuma on the north to the Gulf of Basilikos, south of Milêtos, a length of not more than 100 miles in a straight line, but with a coast three times that length, owing to the many sinuosities and the form of the large peninsula opposite the island of Chios. The Ionian territory did not extend inland above 40 miles from the coast; as far as Mounts Sipylos and Tmôlos. The principal rivers of Ionia were the Hermos, the Kaustros, and the Maiandros.

The Asiatic Ionians early attained a high degree of commercial and maritime prosperity. Milêtos alone is said to have founded seventy-five towns or colonies. They became wealthy and luxurious. The remains of their monuments prove their taste for the arts; and their temples and public buildings rivalled those of European Greece. The religion of Ionia had splendid temples and ceremonies, having a mixture of Oriental gorgeousness and wild imagery which made a remarkable faith. The Ephesian ARTEMIS, the Didymaian Apollo at Branchidai near Milêtos, and the Klarian Apollo at Kolophôn were divinities hardly connected except by name with the Hellenic gods of the same names. The temple of Artemis at Ephesus was one of the "wonders of the world," famous throughout antiquity. These rich trading Ionian cities were luxurious and refined beyond anything conceived by their European relatives. The fine Ionic order of architecture is due to them, the earliest as well as the grandest school of Greek painting is also theirs. They boast Zeuxis, Apellês, and Parrhasios. The literature of Greece may be said to have originated on the coast of Asia Minor. The historian Hekataios was a native of Milêtos; Thalês, one of the earliest philosophers, was from the same country. Anacreon was a native of Teos; and Herodotus, though a Dorian, adopted, in his history, the language of his Ionian neighbours.

The subjection of the Ionian to the Lydian kings, their conquest by Crœsus who, in his turn, submitted to the Persian Cyrus, B.C. 546, and their subsequent struggle with the power of Persia, B.C. 500 and onwards, are the chief events in their history to B.C. 479, the date of the battle of Mukalê, which finally liberated them. From that time their history is connected with that of Athens and Sparta, until the peace of Antalkidas, B.C. 387, by the terms of which the Asiatic cities were given up to Persia. Their subsequent history under Alexander and his successors can be very obscurely traced. Under the Roman Empire several of the cities of Ionia still maintained the rank of wealthy cities, such as Smyrna and Ephesus.

IO'NIAN ISLANDS, the collective name given to the islands of Corfu, Cephalonia, Zante, Santa Maura, Theaki, Paxo, Cerigo, and some small islets, all situated in the Ionian Sea, off the west coast of Albania and the coast of Greece. The seven principal and only inhabited islands are Corfu, Cephalonia, Cerigo, &c., Leucadia, Paxo, Ithaca, and Zante, with an area of about 1006 square miles.

The islands rise in irregular rugged abruptness from the sea, and their structure consists chiefly of limestone, gypsum, and sandstone. Oil, wine, corn, some cotton, the small species of grape called currants, and other fruits, and flax, are the chief productions; the olive is extensively cultivated in all the islands; the currant is grown in the greatest perfection in Cephalonia and Zante. Earthenware, salt, soap, and some coarse woven goods are the principal industrial products. Shipbuilding is also an important branch of industry, and many of the inhabitants are engaged in maritime trade and navigation. The fisheries also give employment to a considerable number of hands.

The imports consist of sugar, coffee, and drugs; raw and manufactured cotton and silk; wool and woollen cloth, glass, hardware, staves and hoops; iron, timber, wheat, Indian corn, rice, cheese, flour, fish, cattle, sheep, tobacco, &c.

The principal exports to the United Kingdom from the Ionian Islands are currants and olive oil. The chief imports from the United Kingdom are cotton manufactures, cotton yarn, coals, apparel, and woollens.

Besides sending deputies to the Parliament of Greece, and taking their share in the legislative government of the kingdom, the seven islands have each a council of five members, selected out of a list of ten furnished by the syncletæ, with whom five other active functionaries are nominated by the Greek government to act as an executive body. The judicial power is lodged in a supreme court at Corfu, comprising four ordinary and two extraordinary members; of the former, two must be native Ionians, and two are appointed by the central government. The ordinary members decide common causes, and, in cases of difference of opinion, appeal to the extraordinary members. Subordinate to this court are four tribunals on each island, making twenty-one in the whole, and under them again are justice of peace courts for minor offences and small civil suits.

The climate of the Ionian Islands is mild and healthy; the winters are rainy, and attended by boisterous winds; the heat in summer is moderated by the north-east wind; it is only when the sirocco blows that any inconvenience is experienced from the heat. Shocks of earthquake are often felt in winter, especially in Zante.

There are a university and an ecclesiastical college for clergy of the Greek Church at Corfu; and each of the islands and chief towns has a school, in which ancient Greek and Latin, modern languages, and mathematics are taught. Besides these educational establishments there are numerous district schools.

About four-fifths of the whole population are of the Greek Church, which is the established religion, and are under the spiritual government of an exarch or primate, which office is held for five years in rotation by the Greek archbishops of Corfu, Cephalonia, and Santa Maura; each island has besides its own archbishop or bishop. The rest of the population, with the exception of some of the British residents and about 5000 Jews, are Catholics, who are superintended by one archbishop and two bishops. The language of the islands is modern Greek. The inhabitants are of Greek and Albanian descent, with a considerable admixture of Italian blood. The chief islands are described in separate articles.

The Ionian Islands were subject to Venice from 1386 to 1797, when they were ceded to France. They were seized by Russia and Turkey in 1800, by France in 1807, by Great Britain in 1809, and on the 5th November, 1815, were formed into a republic (the Septinsular Republic) under the protectorate of the latter, and so remained till October, 1863, when the Parliament at Corfu unanimously voted their annexation to the kingdom of Greece, which was accomplished, with the consent of the British government, in 1864.

IO'NIAN MODE, in music, is that one of the ancient Greek scales which is our scale of E♭ minor with D♭ instead of D♮ for a seventh, thus:—

Greek Ionian Scale. E♭ is the *mesê*.

Hypo-Ionian (our dominant) was the similar scale from B♭ below, as a mesê. *Hyper-Ionian* (our subdominant) was the similar scale from A♭ above, as a mesê. The Greek dominant (hypo-) starting below the keynote gave notes on each side the keynote, and was a more useful scale than the main key. For the relation of Ionian to the other Greek scales or modes see GREEK MUSICAL SYSTEM.

In the *ecclesiastical musical system* of the middle ages (a mere travesty of the Greek), Ionian was the name given to the scale of C, which happens, though it is quite an accident, to be our major scale. It was also called Iastian. Hypo-Ionian or Hypo-Iastian in the church modes was its plagal, that is to say, had the same "final" C, but began on the note G. It is odd that the scale which is our normal was not liked by the ancients, indeed, it was disallowed by many musicians in the dark ages. See MODES, ECCLESIASTICAL.

IO'NIAN SCHOOL OF PHILOSOPHY. This comprises several of the earliest philosophers of Greece, whose speculations were chiefly based on physical characters, and who, with one or two exceptions, were natives of the Ionian colonies in Asia Minor. The chief Ionian philosophers are Thalês, Anaximenês, and Anaximandros (Anaximander) of Milêtos, Pythagoras of Samos, Xenophanês of Kolophôn, Hêrakleitos of Ephesus, Anaxagoras of Klazomenai, &c. Those named are fully treated of in their separate articles. The general tendency of Ionic philosophy, as might be expected from so sensuously-refined a society, was the investigation of matter. Their doctrines vary very much, but nearly all seek for some ἀρχη or root-principle demonstrating the unity of life with matter, that matter is nature and vitality, and that life is inseparably connected with matter. But while the earlier teachers seek mainly the material principles of things Hêrakleitos dwells upon origin, development, and decay, the constant flux and passage of all things.

ION'IC DIALECT, one of the four written varieties of the ancient Greek language, was spoken in the Ionian colonies of Asia Minor, and in several of the islands of the Ægean Sea. As the new Ionic it is distinguished from an older, which was the common origin of itself and the Attic. The old Ionic was widely diffused, and its use was coextensive with the Ionian settlements in the Peloponnesos and Northern Greece. The language of epic poetry, Homer's in especial, arose out of this original tongue, which after the Dorian conquest passed, on the one hand, with the fugitives into Asia Minor, while on the other it continued to be spoken, for a while at least, by the conquered peasantry who remained in Greece Proper. Herodotus (i. 142) distinguishes four varieties of the new Ionic, in one of which he wrote, and though a Dorian, he has left us the best and most complete specimen of it. Hippocrates and Galen also wrote in this dialect.

ION'IC ORDER. See GREEK ARCHITECTURE.

IO'TA or **JOT** was the Greek name for *i*, the smallest letter in the Greek (as it is in our own) alphabet. The Hebrew name for the letter was also *jod* or *yod*. The letter has the force of *y* rather than of *j*; nevertheless *iota* is Englished into *jot*, as in Mat. v. 18, following the Vulgate. Its use was proverbial in antiquity, as meaning an infinitesimal quantity; and in both the forms it has been and still is in frequent use in English. Shakspeare, reckless as usual of the scholarly meaning of his words, uses *jot* in odd situations sometimes, as witness the famous line of Portia—

"The bond doth give thee here no jot of blood."

I'OWA, one of the United States of North America, had its boundaries defined by an Act of Congress passed 4th August, 1846. It has an area of 55,045 square miles. It is bounded N. by Minnesota; E. by Wisconsin and Illinois, from which it is separated by the Mississippi River; S. by Missouri; and W. by the Nebraska Territory and Dakota, from which it is separated by the Missouri River. The population was 43,112 in 1840; 192,214 in 1850; 1,191,792, in 1870; and 1,624,620 in 1880.

The surface is undulating and beautiful, with alternate forests and prairies. There are no mountains, but bold bluffs with picturesque ravines line the rivers, which, rising in the elevated grounds of the northern parts of the territory, flow eastward into the Mississippi, westward and southward into the Missouri, and northward into the British possessions. The Des Moines, the most important of these, has its sources in Minnesota, and traversing the entire state, forms near its mouth a small portion of the southeast boundary. Its length is about 450 miles, 250 of which are navigable for light steamboats at high water. The other rivers which flow into the Mississippi, proceeding in order northwards, are the Skunk, Iowa, the Red Cedar, Wapsipinicon, Makoqueta, Turkey, and Upper Iowa. The Skunk is about 200, the Iowa 300, and the rivers last named from 100 to 200 miles in length. The Iowa is navigable for steamboats 110, and the Cedar River 60 miles. The Makoqueta and the Wapsipinicon have rapid currents and furnish abundant water power. The Missouri, and its tributary the Great Sioux, form the western boundary; the latter has a course of little more than 100 miles. In the most northern and north-eastern part of the state the country is flat and swampy, and there are numerous lakes.

The soil is exceedingly fertile, and the climate rather extreme; the range of temperature being 110° Fahr. the summers are very warm, from 70° to 92° Fahr., and the winters very cold, the rivers being frozen during two or three months every winter. Maize, wheat, barley, potatoes, fruits, wool, tobacco, and furs are the chief products; and lead, copper, zinc, and iron ore are abundant. Portions of the state are occupied by the Ottawa, Chippeway, and several other Indian tribes.

Iowa was separated from Wisconsin in 1838. In 1855 Fort Des Moines was made the capital. The state is now being rapidly covered with railways. It is divided into ninety-nine counties, and returns two members and eleven representatives to Congress.

IPECACUAN'HA, the name of a plant and also of a medicine obtained from its roots. The plant, *Cephaëlis ipecacuanha*, is small and shrubby and bears a small white blossom, followed by a dark purple berry. It grows in moist woods in Brazil, and is gathered chiefly by the Indians, who prepare the root for the market by drying it in the sun. As met with in commerce it is in irregular contorted pieces, 3 or 4 inches long, and about the thickness of a small quill. The active portion of the drug is found in the bark of the root, the central tough woody fibre being almost inert. Three varieties—the brown, red, and gray or grayish-white—are known, but all are produced from the same plant, the differences being caused by the age of the plant, mode of drying, &c. In 1873,

owing to a great rise in the price of the drug, attempts were made to grow the plant in India, and some cuttings were sent out from the Botanic Garden of Edinburgh for that purpose. The plants were found to thrive there in suitable situations, but the experiment has not up to the present proved a commercial success.

Ipecacuanha taken in doses of from 15 to 30 grains of the powdered root is one of the most useful emetics known in medicine. It is mild in its action, and the effect of the drug is not usually felt until it has been swallowed for twenty minutes or half an hour. Taken in minute doses it is very efficacious in checking vomiting arising from natural causes, and it is one of the best remedies known for the morning sickness of pregnancy. In large doses of from 60 to 90 grains it acts almost as a specific in the cure of dysentery, and it was in the treatment of this disease that it was first introduced into Europe about the close of the seventeenth century. In doses of from 1 to 5 grains it excites nausea and depression, and combined with opium and sulphate of potassa in Dover's powder it acts as a powerful diaphoretic. It is also a stimulant or irritant of the mucous membrane, and hence forms one of the chief ingredients in many cough medicines and lozenges. A very useful form of the drug is that known as ipecacuanha wine, and this used in the form of spray is one of the best means of alleviating the symptoms of chronic bronchitis.

IPHIGENEI'A, whose name is asserted with great plausibility to mean *Jephthah-geneia*, daughter of Jephthah, and whose legend is said to be the Hebrew legend transmitted through the Greek myths, was the daughter of Agamemnôn and Klutaimnêstra (Lat. *Clytemnestra*). The king when hunting had killed the favourite stag of Artemis, and consequently the goddess delayed the Greek armament prepared to sail for Troy, which lay wind-locked at Aulis. The soothsayers declared that the virgin must be sacrificed. She was actually (*horribile dictu*) brought to the altar by her father, who sent home for her, telling his wife to bring her that he might marry her to Achilles. Artemis snatched her away in a cloud to Tauris (the Crimea), substituting a stag as the victim. At Tauris Iphigeneia served in the temple, performing the savage sacrifices (even of human life) which that variety of the worship of Artemis demanded. One day two shipwrecked strangers were brought her to sacrifice, as was the custom. In one of them the priestess saw her brother Orestês. He had come to carry off the statue of the goddess, which was believed to have fallen from heaven, for that, as he was told by an oracle, was the only thing which would satisfy the Furies, tormenting him continually for the murder of his mother, Klutaimnêstra. Iphigeneia then felt no religious scruples at assisting her brother, and ran away with him from the cruel position she had so long occupied. She still continued to guard the statue as priestess, near Marathon. The Lacedæmonians declared that they and not the men of Attica possessed this ancient statue. At any rate, both in Sparta and Athens human sacrifices were offered anciently to Iphigeneia, and her worship was apparently confused with that of the Tauric Artemis.

IPH'IKLES was the half-brother of Hêraklês; he was the son of Amphitruon as the demigod was the son of Zeus, by the same mother Alkmênê. Iphiklês was one night younger than Hêraklês. His son Iolaos was the famous companion of his uncle. Iphiklês himself was with Hêraklês in many expeditions, as the boar hunt in Kaludôn (or Calydon), &c. There was another hero of the same name (son of Thestios) who was among the Argonauts, and a third Iphiklês was also with that famous company, who was famous for his swiftness of foot, and was the father of Protesilaos, the first hero to perish in the Trojan War, as he leapt upon the shore from the leading Greek galley.

IPHIK'RATES, an Athenian general, who introduced a happy innovation upon the ancient routine of Greek tactics, during that general war which was ended B.C. 398 by the submission of the revolted Ionian cities to Persia at the peace of Antalkidas. Iphikratês laid aside the weighty panoply which the regular infantry, composed of Greek citizens, had always worn, and substituted a light target for the large buckler, and a quilted jacket for the coat of mail; at the same time he doubled the length of the sword, usually worn thick and short, and increased in the same (or by some accounts in a greater) proportion the length of the spear. It appears that the men also carried missile javelins, and that their mode of attack was to venture within throw of the heavy column, the weight of whose charge they could not have resisted, trusting in their individual agility to baffle pursuit. When once the close order of the column was broken, its individual soldiers were overmatched by the longer weapons and unencumbered movements of the lighter infantry. In this way Iphikratês and his targeteers (*peltastai*) gained so many successes that the Peloponnesian infantry dared not encounter them, except the Lacedæmonians, who said that their allies feared the targeteers as children fear hobgoblins. They were themselves taught the value of this new force, B.C. 392, when Iphikratês waylaid and cut off nearly the whole of a Lacedæmonian battalion. Iphikratês afterwards commanded in the Hellespont, B.C. 389; in Egypt, at the request of the Persians, B.C. 374; relieved Corcyra in 373, and served with credit on other important occasions. He was tried B.C. 357, when he was about sixty years of age, for refusing to fight in a storm during the Social War, and was triumphantly acquitted, but he undertook no further command. "A commander may be beaten but never surprised" is a proverb claimed by several authors (Napoleon among the rest); but Iphikratês is the first to formulate the epigram. "The worst words a commander could say," said he, "would be, I should never have expected that." The honours paid him by the Athenians were unprecedented, but were modestly borne. The great general was son of a shoemaker, and to the last retained the simplicity of his early habits. He died about 350 B.C.

IPOMŒ'A (Gr. *ips*, a worm, and *homoios*, like), a genus of plants of the order CONVOLVULACEÆ, which is very closely allied to Convolvulus or bindweed. The species are very numerous, about 400 being described, and are found in the tropical parts of Asia, Africa, and America. A few ascend the mountains in such latitudes. Like the kindred genus Convolvulus, which affords us scammony, many of the species of Ipomœa are useful for their purgative properties. The dried tubercles of the jalap plant, *Ipomœa jalapa* (*Exogonium purga*), has been extensively employed as a powerful medicinal agent. See JALAP.

Ipomœa hederacea produces the kala-dana or black seeds of India. It is a twining annual, with cordate, three-lobed leaves, and large salver-shaped corolla of a bright pale blue colour. It is a native of the tropics. The seeds are black, about a quarter of an inch long, and shaped like the segment of an orange. They are much used in India as a substitute for jalap, 30 to 50 grains of the powdered seeds being a safe dose.

Ipomœa Turpethum is also a good substitute for jalap, and although it is not so powerful, it is without the disagreeable taste and smell of that drug. The purgative properties of the various species depend on the presence of a peculiar resin contained in the juice. Many species are cultivated for the beauty of their flowers and the graceful habit of their twining stems. *Ipomœa mutabilis* is one of the most beautiful of climbing plants.

Bentham and Hooker, in their "Genera Plantarum," include several groups as subgenera which had been classed as distinct by Choisy in De Candolle's "Prodromus;" such are Batatas, Calonyction, Exogonium, Pharbitis, and Quamoclit. A species of the BATATAS section is the sweet potato. The bona-nox (good-night) of tropical America,

so called from the large white flowers only opening at night, belongs to the Calonyction. The jalap plant is an Exogonium. Kala-dana is the product of *Pharbitis nil*, included in the flora of British India under *Ipomœa hederacea* of Jacquin. The species belonging to the Quamoclit section have red or crimson corollas, with a long slender tube. *Ipomœa Quamoclit* has feathery leaves; other species have undivided cordate leaves.

The following are the characteristics of the genus:—corolla campanulate or salver-shaped, with limb five-plicate, and margin five-cornered or five-lobed; ovary, with two to four cells, four ovules, style filiform, stigma globose or didymous; capsule with four (or two) valves, sometimes bursting irregularly. The species are herbaceous climbers.

IPSAMBUL', ABOUSAMBUL or **ABU-SIMBEL,** a village of Nubia, remarkable for containing two of the most perfect specimens of Egyptain rock-cut temples. These excavations are on the west side of the Nile, 22° 22′ N. lat., 31° 40′ E. lon. Near Ipsambul the river flows from south-west to north-east through sandstone hills; on the west bank a valley opens and displays two faces or walls of rock, each of which has been fashioned into the front of a temple. The excavations are made in the solid mass of the mountain. The smaller temple stands 20 feet above the present level of the river, and is in a state almost as perfect as when it was just completed.

The façade of this excavation is the exact prototype of those masses of Egyptian architecture called *própyla*; the face slopes outwards towards the base, thus preserving one chief characteristic of the pyramidal style of building. On each side of the doorway are three standing colossal figures, about 30 feet high, cut out of the rock and deep sunk in niches, to the back part of which they are attached by a portion of the rock that has been allowed to remain. The figures are in a standing position, with one foot advanced, looking towards the river. On each side of the larger figures stand smaller ones, from 4 to 6 feet high. The whole façade is ornamented with hieroglyphics, which it is now ascertained contain various repetitions of the name of Ramses, one of the several ancient monarchs of Egypt who bore that name.

The width of the front of this temple is about 90 feet, the depth 76 feet. From the door a passage leads to a room 35 feet by 36½, supported by six square pillars, three on each side, with Isis-headed capitals. From this apartment we pass into a narrow kind of vestibule, and thence into the adytum or recess, which contains the remains of a sitting statue cut in the rock. The interior of this excavation is richly adorned with painted bas-reliefs, representing offerings of palm branches and the lotus to Osiris, with other subjects usually found in the Egyptian sacred buildings.

IPS'WICH, a market-town, municipal and parliamentary borough, the county town of Suffolk, and a river port, is 68 miles north-east from London on the Great Eastern Railway. It occupies a gentle declivity near the confluence of the Orwell and Gipping, the former river being crossed by a handsome iron bridge. Camden termed it "the Eye of Suffolk," an expressive phrase, amply justified by its past and present importance. The older portions of the town formerly consisted of narrow, irregular streets; but wonderful improvements have been effected, and Ipswich can now fairly rank with almost any provincial town of the same size in England. Many of the public buildings have been rebuilt, new and handsome shops erected, and in the suburbs some very pretty villas and fine mansions have been constructed. To most of them well laid out gardens are attached, which give them a very pleasant appearance. The town has also been thoroughly drained, and an ample supply of water obtained, and it is now an unusually healthy place. The manufactures consist chiefly of agricultural implements. but there are also ship and boat building yards, sailmaking and staymaking establishments, breweries, corn-mills, iron and soap works, a large shoe factory, silk factory, flax-mills, and lime, cement, and artificial stone works. Large quantities of artificial manure are also made from coprolites found near the town. Messrs. Ransome's agricultural implement factory is one of the largest in the kingdom. It covers about 12 acres, and employs about 1000 workmen. Steam ploughs, thrashing machines, winnowing machines, turnip-cutters, chaff-cutters, hurdles, rakes, forks, railway chairs, &c., are made in large numbers. The port is formed by the estuary of the Orwell, and has been much improved by the works opened in 1882. An approach from the river to the dock has been dredged to a depth of 22 feet at spring tides. Consequently vessels drawing 18 feet of water can now pass up the Orwell and be admitted with perfect ease through the new dock gates. Arrangements have further been made by which, even at low water, vessels can be moored in 22 feet within a few miles of the town. The exports consist chiefly of agricultural produce, implements, and machinery; and the imports of spirits, wine, oilseed cake, corn, coal, iron, and timber. The number of vessels registered as belonging to Ipswich in 1885 was 160, of 10,500 tons burden. The entries and clearances average 3500 (of 260,000 tons) per annum. The principal public buildings are the churches of St. Clement, Helen, Lawrence, Margaret, Mary at Elms, Mary at Key, Mary at Stoke, Mary at Tower, Matthew, Nicholas, Peter, Stephen, and Holy Trinity. The church of St. Mary at Tower, which is the mother church of the town, was thoroughly restored from 1863 to 1870, at a cost of about £15,000. St. Clement's and St. Stephen's have also been partially restored. There is a very handsome Roman Catholic chapel, about sixteen other chapels for different denominations of dissenters, and a Jews' synagogue. To the north of the handsome church of St. Mary Key, which has a lofty tower, formerly stood a house of Black Friars, called the Priory of St. Peter's, the site of which was purchased by the corporation, and confirmed to them in 1572 by the appellation of Christ's Hospital. A portion of this edifice is now occupied as an hospital for poor boys, who are gratuitously maintained, clothed, and educated. The town also contains a free grammar-school, founded by Cardinal Wolsey, and intended by him to have formed part of a college preparatory to Christ Church, Oxford. It was chartered by Queen Elizabeth, and rebuilt in 1851. It now possesses eleven scholarships, and has two exhibitions at Pembroke College, Cambridge. The other buildings comprise a shire-hall, county and borough jails, handsome custom-house, post office, and corn-exchange, opened in 1882; assembly room, public hall, masonic hall, music hall, an admirable museum, library, and school of art, opened in 1882; mechanics' institution, industrial training-school, a working men's college, hospital, two lunatic asylums, several almshouses, and other charitable institutions. A town-hall was opened in 1868, at a cost of £16,000. The building is the finest of its class in the eastern counties. The banks and commercial buildings are generally of an ornamental character. Christ Church Park, on the summit of the hill, is thrown open to the public on special occasions by its owner, and the upper and lower arboretum are beautifully laid out, and form most agreeable promenades. Cardinal Wolsey was born at Ipswich. His birthplace, the Old House, is very picturesque, with its carved pilasters, panels, and brackets. The municipal borough, divided into five wards, is governed by a mayor, ten aldermen, and thirty councillors. The parliamentary borough, which is co-extensive with the municipal, has returned two members since the time of Edward I. The population in 1881 was 50,546; in 1871 it was 42,947. Ipswich was destroyed by the Danes in 991. In Domesday Book it is called Gypeswic (from the river Gipping in the vicinity).

IPS'WICH, a rising town in Queensland, is situated at the head of navigation on the river Bremer, 23 miles west of Brisbane. The principal part of the town is on the south side of the river. It is connected with the north by a substantial iron bridge. It is in direct railway communication with Brisbane. Ipswich, originally known by the name of Limestone, is the second largest town in Queensland. It is pleasantly situated on the slopes of three hills which drain into the Bremer, and is very salubrious. The population in 1881 was 7048. The district is an agricultural one. The public buildings comprise the churches and chapels, among them being Anglican (St. Paul's), Roman Catholic (St. Mary's), Presbyterian, Wesleyan, Lutheran, Baptist, Congregational, Primitive Methodist, and United Free Methodist chapels; hospital, the court-house, land-office, custom-house, the post and telegraph office, the grammar school, and the school of arts, with a library of 3000 volumes. The town also has some good public halls and branches of several banks. There are some rich seams of coal on the banks of the Brisbane and Bremer near the town, which have been worked for some time with profitable results; the coal crops out from the surface, and needs little labour to obtain it.

IRAN', the modern native name of Persia. See ASIA.

IRAWAD'DI or **IRRAWAD'DY**, the principal river of Burma, rising in the northern part of the country and traversing the Pegu division from north to south. It rises in the southern slopes of the Patkoi Mountains—one branch in lat. 27° 43′ N., lon. 97° 25′ E., and another in the same hills a few days' journey further eastward. These two, known as the Myit-gyi or "large river" and the Myitnge or "small river" respectively, unite to form the Irawaddi in about 26° N. lat. The chief tributaries are the Mogoung, from the west, which throws its waters into the main stream (here 600 yards wide) in lat. 24° 50′ N., and the Shwe-li and Kyeng-dweng. The general course of the Irawaddi is from north to south. Shortly after leaving the mouth of the Mogoung it enters the first or upper defile. Here the breadth of the river varies between 50 and 250 yards; the current is very rapid, and the return waters occasion violent eddies and whirlpools. When the river is at its lowest no bottom is found even at 40 fathoms. At Bhamo (Ba-mhaw) it receives the Ta-peng from the east; and then, turning south, after a long bend to the westward it enters the second defile, which is exceedingly picturesque, the stream winding in perfect stillness under high bare rocks rising sheer out of the water. Further down, and not far from Mandalay, is the third or lowest defile. The banks are covered at this point with dense vegetation, and slope down to the water's edge; at places appear almost perpendicular, but wooded, heights. Except when the river is at its highest, the navigation of the two lower defiles is easy and safe for all but very long steamers. The valley of Ava begins below this third defile, and lies entirely on the east side of the Irawaddi; the range of hills, terminating at Sagain opposite Ava, hems the river closely in on the west. At Akouk-toung, where a spur of the Arakan Hills ends abruptly in a precipice 300 feet high, the river enters the delta, the hills giving place here to low alluvial plains, now protected on the west by extensive embankments. From 17° N. lat. the Irawaddi divides and subdivides, converting the lower portion of its valley into a network of intercommunicating tidal creeks. It reaches the sea in lat. 15° 50′ N., and lon. 95° 8′ E., by nine principal mouths—viz. the Bassein, and its eastern entrance the Thek-ngay-thoung, the Rangoon, To or China Bakir, Pya-pun, Kyuntun, Irawaddi, Pya-ma-law, and the Rwe. The Bassein and Rangoon mouths are the only ones used by sea-going ships. The Irawaddi delta is constantly encroaching on the sea, owing to the immense quantity of silt brought down by the river, and is cut up into numerous islands by a vast labyrinth of tidal creeks and channels. Scattered along these in the extreme south are temporary villages, occupied during the dry season by salt-boilers and makers of *nga-pi* or fish paste. The area of the basin of the Irawaddi is 158,000 square miles; its total length from its known source to the sea is about 900 miles, the last 240 of which are in British territory. It is full of islands and sandbanks, many of the former, and all the latter, being submerged during the rains; its waters are extremely muddy, and the mud is carried far out to sea. The river commences to rise in March; about June it rises steadily, and attains its maximum height about September, at which time it is, at Prome, from 33 to 34 feet above its dry-season level. Below the latitude of Myan-oung, the Irawaddi inundates large tracts of country on its eastern or unprotected bank. The river is navigable at all seasons by steamers of light draught as high as Bhamo, and during the dry season, for steamers drawing 6 feet, as far as the British frontier.

The broad channel of the Irawaddi has always been the sole means of communication between the interior and the seaboard. From time immemorial the precious stones, minerals, &c. of Upper Burma, Siam, and the Chinese frontier provinces, have been brought down by this route. At the present day the great bulk of the trade is in the hands of the Irawaddi Flotilla Company, an important English carrying firm; but native boats still maintain a strenuous competition.

IRELAND, an island on the north-west of Europe, forming part of the United Kingdom of Great Britain and Ireland, extends from 51° 26′ to 55° 21′ N. lat. and 5° 20′ to 10° 26′ W. lon. It is surrounded by the Atlantic on all sides except the east, where it is separated from Great Britain by St. George's Channel, 47 miles across where narrowest; the Irish Sea, 138 miles; and the Northern Channel, 13 miles. Its shape is that of a rhomboid, the greatest diagonal of which is 302 miles and the lesser 210 miles; the greatest length on a meridional line is 225 miles; the greatest and least breadths on parallels of latitude, 174 and 111 miles, comprising an area of 32,524 square miles, or 20,819,928 acres.

Coasts and Islands.—The eastern coast is comparatively tame and unbroken, while the northern, western, and southern are generally bold, often fringed with gigantic cliffs, and very deeply invaded by the ocean. The eastern line of sea-board is also encumbered with sandbanks, bars, and sunken rocks, rendering careful navigation necessary, or interfering with it altogether, whereas in the other directions the deep water of the Atlantic comes close to the strand, and the numerous inlets rank with the finest harbours in the world for easy access, capaciousness, and shelter. The eastern side of Ireland, like that of Great Britain, has few subordinate isles associated with it; but an immense number stud the western shores, mostly small, yet thickly peopled, and situated at an inconsiderable distance from the mainland. Valentia Island, on the southern side of the entrance to Dingle Bay, was for some time held by the Spaniards, who were, however, finally expelled by Cromwell. During the period of their occupation commercial intercourse was active between places on the adjoining shores and Spain, traces of which remain to the present day in the names of many localities, and in the peculiar styles of building. The town of Galway has its open space called the Spanish Parade, and both there and at Dingle are several old houses with inclosed courtyards after the Spanish fashion. Legends respecting green islands rising out of the sea, enchanted islands floating on the ocean, and fairy castles appearing and vanishing to seaward, are common in the old Irish chronicles. They may be referred to optical illusions caused by the phenomenon of the mirage, similar to the Fata Morgana of Sicily, and now often observed in the strait between Rathlin Island and the coast of Antrim. In this neigh-

bourhood the shores consist of magnificent ranges of basaltic columns, which form the cliffs and promontories of Fair Head, Bengore Head, and the Giants' Causeway. These polygonal pillars, made by nature herself, seem at a distance like grand monuments of human architecture, or occasionally like ruined edifices, surrounded by a wild waste of rocky fragments, which, in the course of centuries, have been dislodged by the gradual action of the elements, or wrenched away by the ocean in its storms.

Surface.—The structure of the surface of Ireland is extremely simple, consisting of an extensive central plain skirted by imposing mountains. Its general aspect is less rugged than the north and west parts of Great Britain, but not so tame as the east. The great central plain extends east and west from sea to sea, between the bays of Dublin and Galway, and from the shores of Lough Neagh on the north to the confines of Waterford on the south. Though varied by swells, the highest ground within its limits, Moat-a-grenogue, in Westmeath, is little more than 300 feet above high-water mark. The foundation rock is carboniferous limestone, the same which has the name of the mountain limestone in England, from being developed there in ranges of considerable height and magnitude. Upon this substratum rest accumulations of clays and gravel, forming a rich cultivable soil, but through a vast proportion of the area it is overlaid with peat-bogs, a characteristic formation of Ireland. The bogs are not confined to the plain, but occur on the uplands, though to an inferior extent. They were estimated by Dr. Kane to occupy one-seventh of the whole surface of the island. The largest is the famous Bog of Allen, which stretches in a vast plain across the centre of the island, or over a large portion of Kildare, Carlow, King's and Queen's counties—having a superficial elevation of 280 feet. Extensive tracts of deep wet bog also occur in Longford, Roscommon, Mayo, Galway, and other counties, and give a peculiarly dreary and desolate aspect to the scenery. They are composed of decayed and compressed vegetable matter or peat, with an overgrowth of unproductive living vegetation, holding more or less stagnant water. They seem to have arisen from interruptions offered to the drainage by fallen timber or the gravel ridges, whence shallow pools resulted, specially adapted for the growth of aquatic plants, as *Sphagnum palustre*, and other mosses, which luxuriated till a spongy mass of vegetation was formed, decaying, rotting, and compressing into peat below, while continuing to shoot out new plants above. The peat extends to the average depth of from 20 to 25 feet, though sometimes to 40 feet; dried by the summer heat, it is in many districts the only available fuel. The bogs of Ireland have no analogy to the fens of England, as they lie in all cases so far above the sea-level as to be readily susceptible of drainage and reclamation. Notwithstanding their moisture they are not insalubrious, owing to the large quantity of tannin which they contain; and such are their antiseptic properties, that bodies of men and animals have been taken out of them with but few symptoms of decay after the lapse of generations. Trunks of oak, yew, pine, and birch are met with at great depths, and remains of the gigantic horned elk are very abundant. Various ornamental articles are made of the bog-timber, that of the oak being generally as black and hard as ebony, while the colour of the yew is a rich brown approaching to chocolate.

The highlands which border the central plain do not form a continuous belt around it, but occur in detached groups or ranges of limited extent, generally close to the shores, and often forming the coast-line. They consist of primary strata, with various igneous rocks, which have protruded through the great pavement of carboniferous limestone, rising to considerable elevations above it. The loftiest masses on the eastern side are the Mourne Mountains, in the county of Down, which approach the height of 2800 feet, and those of Wicklow, which slightly exceed 3000. In the north-west and west, Donegal, Mayo, and the wild district of Connemara have summits of nearly equal altitude, with stupendous sea-cliffs. But the most generally rugged district is the south-western, chiefly the county of Kerry, where several ranges run parallel to each other, between which the ocean far advances its waters, and is overlooked by the highest points of Ireland. Occupying a specially maritime site in the peninsula north of Dingle Bay, Mount Brandon rises 3120 feet, but is surpassed by Carn Tual, 3404 feet, not far from its southern shore, one of Macgillicuddy's Reeks, a ridge running between the Lakes of Killarney and the coast. The Reeks or rocks have smooth, sharp, conical summits; and are traditionally said to derive their specific name from that of an old extinct family in the neighbourhood. Carn Tual rises with a uniform slope on every side; and a very striking panorama is in view from it of winding inlets, estuaries, and peninsulas, whenever the volumes of mist and cloud which roll up from the Atlantic are withdrawn. Macaulay has eloquently described the district, now brought within easy reach: "The mountains, the glens, the capes stretching far into the Atlantic, the crags on which the eagles build, the rivulets brawling down rocky passes, the lakes overhung by groves in which the wild deer find covert, attract every summer crowds of wanderers sated with the business and the pleasures of great cities. The landscape has a freshness and a warmth of colouring seldom found in our latitude. The myrtle loves the soil. The arbutus thrives better than even on the sunny shores of Calabria. The turf is of livelier hue than elsewhere; the hills glow with a brighter purple; the varnish of the holly and ivy is more glossy; and berries of a brighter red peep through foliage of a brighter green." Besides these highlands, several groups are distributed over the southern counties, the Galty, Knockmealdown, Silver Mine, and Slieve-Bloom Mountains, some of which range to an important altitude.

Rivers.—Ten principal river-systems are distinguished, which, though not of much value in a navigable point of view, except in the instance of the Shannon, supply an amount of water-power fitted for industrial purposes which few countries of the same extent possess, and are often associated with highly picturesque scenes, adding to the beauty or impressiveness of the landscape by their placid flow, wild dash, or roaring cascades.

River	Length in Miles.
Shannon,	254
Barrow,	100
Blackwater,	100
Bann (Upper and Lower),	65
Boyne,	65
Slaney,	60
Liffey,	50
Bandon,	40
Lee,	35
Foyle (properly so called),	16

The Shannon is the third river in the United Kingdom in the extent of its basin, being only surpassed by the Humber and the Severn, while it is the first in rank as to the length of its navigation. It issues from a bog among the mountains of Cavan, called in the locality the Shannon Pot, flows generally from north to south, forms Loughs Allen, Ree, and Derg, washes the shores of ten counties, meets the tide below Limerick, and then travels westerly to the Atlantic through a long and noble estuary, from 1 to 11 miles broad, answering to Spenser's description, "the spacious Shenan, spreading like a sea." Aided by a few lateral cuttings, the navigation is continuous through upwards of 200 miles, nearly the whole of its course. By one of these cuts the rapids of Doonas above Limerick,

where the bed of the river becomes strongly inclined, are avoided, and the whole body of water, 300 yards wide and 40 feet deep, rushes over and through a succession of rocks for half a mile, forming a scene of great magnificence. The Barrow, next in importance, drains a south-eastern district, and includes in its system the Nore and Suir, popularly called the Three Sisters, from rising in the same neighbourhood, and after a long divergent course pouring their united waters through Waterford Harbour into the Atlantic. In the north the Bann, divided into upper and lower by Lough Neagh, enters the sea below Coleraine; and the Foyle passes Londonderry to the large marine inlet of Lough Foyle. On the eastern side are the Boyne, celebrated for the battle fought on its banks between the forces of William III. and those of James II.; the Liffey, on which Dublin is situated; and the Slaney, which forms at its mouth the haven of Wexford. In the more southerly portion of the island the Blackwater, designated the Irish Rhine from its scenic attractions, discharges itself into Youghal Bay; the Lee forms the fine harbour of Cork; and the "pleasant Bandon, crowned with many a wood," terminates its course at Kinsale, but is now shorn of much of the timber it possessed when the author of the "Faerie Queene" trod its banks.

Lakes.—Lakes are numerously distributed, and occupy a very considerable space in proportion to the whole extent of the surface, amounting to nearly 1000 square miles. They differ generally in form and position from the Scottish lakes; have their length and breadth more correspondent, occur in open districts, and, with one striking exception, have tame borders, level or marshy. Lough Neagh, the largest inland expanse in the United Kingdom, washes the shores of five counties in the province of Ulster, extends 17 miles in length by 10 in average breadth, covers an area of 150 square miles, is a navigable basin, and has waters celebrated for their incrusting quality. [In Ireland the word *lough*, like the similar term *loch* in Scotland, is applied indifferently to fresh-water expanses, inlets of the sea, and the estuaries of rivers.] Lough Corrib, in Connaught, is the next in magnitude, but much smaller. It maintains communication with Lough Mask, about 3 miles to the northward, by a subterranean channel through the intervening limestone isthmus. The connecting stream may be seen at various points in its caverned bed through openings in the superincumbent strata, one of which, called the Pigeon's Hole, 60 feet deep, admits of being descended. Lough Derg, in Donegal, surrounded by dreary moorland hills, and disturbed by violent gusts of wind, has a number of small islands, one of which, called Saint's Isle, is the original seat of St. Patrick's Purgatory. But the place of penance for some centuries has been on Station Isle, now the most celebrated place of pilgrimage in Ireland, from 10,000 to 15,000 persons flocking to it annually, from 1st June to 15th August, for prayer, fasting, and vigils. The Lakes of Killarney, three in number, upper, middle, and lower, mutually connected, are exceptions to the ordinary scenery as to natural attractions, being inclosed by the loftiest of the Irish mountains, with vividly green woods and fine monastic ruins on their shores.

Climate.—The climate is temperate and moist. The number of days on which rain falls varies from 180 to 210 per annum. The crops are more frequently injured by excess of moisture than of aridity. Plants which require artificial heat in England flourish here in the open air; while, owing to the humidity of the atmosphere, many kinds of seeds must be supplied from England or the Continent. This peculiarity of climate is not prejudicial to health; the average of life is much the same as in Great Britain, longevity much greater. The prevalent diseases are low fever and consumption. The mean temperature in the north is 48° Fahr.; in the middle, 50°; and in the south, 52°.

Geology.—The geological structure of Ireland has this striking peculiarity, that most of the great mountain ranges are near the coast, while the central portion is an almost uniform plain, varied only by low hills. The prevailing formations are limestone, granite, mica-slate, clay-slate, old red sandstone, yellow sandstone, and basalt or trap. The limestone extends over the central plain, 120 miles east and west from Dublin to Galway Bay, and 120 miles north and south. Its greatest elevation is about 300 feet, which is the height of the summit levels of the canals that traverse it. The principal tracts of granite are those of Wicklow, Galway, Newry, and Donegal. The mica-slate of Leinster is confined to a narrow fringe, edging the granitic region of the province; in Donegal and Galway it spreads over large tracts. The clay-slate is among the most important rocks, both for extent of area and valuable mineral deposits. The counties of Wexford, Louth, Waterford, Cork, and Kerry are mostly formed of it. In the north it is contained in the district bounded by a line from Longford to Drogheda eastward, and to Donaghadee north-eastward. At Kingscourt, Carrickmacross, and Cavan the clay-slate dips and forms a basin, in which the limestone and coal formations are deposited. Slate is quarried extensively at Killaloe and Westport, in Clare, and in Wicklow. The old red sandstone is chiefly developed in the south: it forms the greater part of Cork and Waterford counties, and of the inland mountain ranges of Knockmealdown, Commeragh, and the Galtees; it shows itself also in several places in Westmeath, Longford, and Leitrim. A large tract of old red and yellow sandstone forms the sea-coast at Killaloe, skirts Loughs Conn and Cullen, and reaches the Atlantic at Westport. An extensive tract in Fermanagh and Tyrone, from Lough Erne to Cookstown, has this rock for its basis. It is also found in patches in Antrim, Derry, and Tyrone. Crystallized gypsum occurs in Derry and Antrim, and selenite at Benburb. Uncrystallized gypsum is raised in large quantities at Carrickmacross. The yellow sandstone usually accompanies the red, and rests upon it. The basalt or trap occupies a very limited area, being confined almost exclusively to the north-east portion of the island, forming the substrata of the county of Antrim and of some portions of Derry and Armagh.

Minerals.—The mineral resources of Ireland are very considerable, but remain largely undeveloped. Coal occurs in ten counties, often in thin seams which detract from its value, or of inferior quality, consisting of anthracite or stone coal, which burns without flame. It was worked at an early period, for pits have been discovered which bear evidence, from the rude implements found in them, of having been sunk by a race anterior to historical records. The coal now used in the towns is chiefly imported from England and Scotland, while peat is exclusively used for fuel by the peasantry. Iron ore is abundant in the basin of the Shannon and other places. It was extensively smelted in charcoal furnaces while the ancient forests lasted, but has been neglected since the supply of wood-fuel failed. Copper is obtained in the counties of Wicklow, Waterford, Cork, and Kerry, and sent for smelting to the coal districts of England and Wales. Lead is much more widely diffused and worked to a greater extent. Small proportions of manganese, antimony, alum, fuller's earth, and pottery clays are included in the other mineral produce, with roofing-slate and building-stone of the best description; and there is an extraordinary variety of ornamental marbles—white, black, ash-gray, dove-coloured, and green, the latter almost as bright in its hue as malachite. The Museum of Irish Industry in Dublin contains a fine collection, carefully classified, of all the geological products of the country. Towards the close of the last century gold was discovered in connection with the mountain streams of Wicklow, which raised high expecta-

tions respecting the auriferous wealth of the district. A schoolmaster, in his solitary walks, found the first nugget in the Ballin Valley stream. He kept the secret to himself, and wandered in his leisure hours, early and late, in search of further treasure. Another party similarly fortunate was not so reserved; and crowds of peasantry were speedily at the spot digging up and washing the soil. The first gleaners made such considerable profits that the government interfered, and regular mining-works were established, till the rebellion of the year 1798 interrupted the enterprise. It was resumed in 1801, but soon abandoned as unremunerative. The stream-gold having been exhausted, and no auriferous veins being discovered in the adjoining rocks and mountains, it became evident that the whole supply had been gathered up. Altogether, the government collected about 944 oz., valued at £3675, but the expenditure was more than three times this amount. Previously the peasantry are supposed to have obtained upwards of £10,000 worth of gold, in pieces from the size of minute grains to lumps weighing 22 oz.

Agriculture, &c.—Ireland is essentially an agricultural country, and upon the cultivation of the soil the mass of the people depend for their subsistence. It was almost exclusively a pasturing country until the middle of the last century. That the soil of Ireland is, however, eminently fitted for tillage appears from the evidence of every intelligent person qualified to give a sound opinion who has visited the country. Arthur Young, who travelled through it in 1776–78, says of Limerick and Tipperary—"It is the richest soil I ever saw." Wakefield, in his "Statistical Account of Ireland," says, "Ireland may be considered as affording land of excellent quality; some places exhibit the richest loam I ever saw turned up by a plough." And the late Mr. M'Culloch, in his valuable work on the "Statistics of the British Empire," confirms these statements. "The luxuriance of the pastures," he writes, "and the heavy crops of oats that are everywhere raised, even with the most wretched cultivation, attest its extraordinary fertility. Natural manures abound in most districts. The greatest portion of the soil lies on a substratum of limestone; marl is raised in many places, as is gypsum or sulphate of lime; coralline sand and seaweed are collected along the shores."

The tenure of landed property in Ireland varies considerably. Formerly, when absolute sale to Roman Catholics was forbidden, the custom prevailed of granting leases either in perpetuity, for 999 years, or for lives renewable for ever. The leases in most general use latterly were for sixty-one, thirty-one, or twenty-one years, with very frequently a life or lives. [For the origin of these peculiar tenures see the section *History*.] In most cases, however, the occupiers were formerly mere tenants-at-will; and it was this circumstance, coupled with the fact that they had no legal claim for compensation for any improvements they effected, which formerly led to such a bad feeling on the land question in many parts of the country, and led to the passing of the celebrated Irish Land Acts. The first of these Acts was passed in 1870, and its basis was that if landlords used their legal right to evict tenants capriciously they should pay them, and that the poorer the man evicted the more proportionally he should get. Besides this the tenant was to be paid for improvements, local customs in his favour were to be legally recognized, he was to be prevented for a time from contracting himsel out of the benefits the bill gave him, and the state was to aid him in purchasing the land in case his landlord wished to sell. These were all great advantages, but the backbone of the measure was the compensation for eviction.

Unfortunately the Act did not have the hoped-for effects, and a still more remarkable Act was accordingly passed in 1881, the main provisions of which may be summed up as follows:—

Fair Rent.—Every tenant from year to year in Ireland of an ordinary agricultural or pastoral holding is entitled to have a fair rent fixed for his holding, either by the county court judge or by a land commission appointed under the Act; or it may be settled by agreement with the landlord, or by arbitration.

Security of Tenure.—Whenever a fair rent is fixed, either by the court or commission, or by agreement, or by arbitration, the rent cannot be raised or altered for fifteen years, nor can the tenant be disturbed during that period. In the last year of the fifteen the tenant can again get the rent settled, and a new term of fifteen years granted, and so on. It is not, therefore, merely a term of fifteen years which the tenant gets, but practically a term renewable every fifteen years. It amounts to this, that the tenant paying a fair rent and treating the land in a proper tenantable way, and not subdividing or subletting his farm, is safe from eviction and from arbitrary increase of rent, while his rent cannot be increased by reason of his own improvements.

Sale of Tenancies.—Every tenant may sell his tenancy for the best price he can get, but the landlord is to have the first right of buying, at a price either agreed on between the parties or to be fixed by the court.

Acquisition of Land—Peasant Proprietors.—A tenant may agree to buy from his landlord his holding, and if the agreement be negotiated through the land court the purchasing tenant will have a guaranteed title, and will be charged only a small fixed sum for law costs. The commission may advance three-fourths of the purchase-money, and the landlord may agree to leaving the remaining one-fourth due upon the security of the premises. The repayment of advances is spread over thirty-five years at 5 per cent.

Arrears of Rent.—Provision was made to help tenants who owed arrears of rent, provided their holdings were valued at £30 or under. Tenants over whom ejectments were pending at the time the Act was passed could also obtain the intervention of the court to have a fair rent fixed and preserve the tenant in his holding, or to enable him to sell his tenancy.

Unfair Leases.—If, since the passing of the Land Act, 1870, a tenant had accepted a lease containing unreasonable provisions, under threat of eviction or other undue influence, the court was empowered to annul such lease and grant another, provided the tenant went to the court prior to 28th February, 1882.

Though now improving, the general husbandry of Ireland was long in a backward state, owing to the minute divisions of land, the system of subletting, the undue dependence of tenants upon landlords or their agents, and political agitation. Besides the cereal produce, of which oats form the largest crop, as suited to the moisture of the climate, a considerable extent of surface is devoted to the growth of flax for the linen trade, chiefly in the northern province of Ulster, with limited spaces in other quarters. Both soil and climate are admirably adapted to this delicate plant. Among the green crops are potatoes. This esculent was introduced about the year 1601 or 1602 by Sir Walter Raleigh, who planted it in his garden near Youghal, from whence it gradually spread over the entire country. The Irish peasantry unfortunately made it their main dependence, attracted by the usually abundant yield and the comparative facility of cultivation. Hence a failure of the crop threatened their very existence. One failure in 1739 sent a fifth of the inhabitants to the grave. Famine, pestilence, and death resulted from the terrible failure of the year 1845, followed by an emigration of the survivors to such an extent as to deserve the name of the Irish Exodus. The calamity illustrated the folly of an entire nation depending upon a single precarious root, and has since stimulated the culture of the corn-bearing plants.

The following table shows the extent of land under each of the principal crops in Ireland in the years 1884 and 1885:—

	Acres (1884).		Acres (1885).
Barley, ...	167,316	...	179,431
Oats, ...	1,347,395	...	1,327,982
Potatoes, ...	798,942	...	797,103
Turnips, ...	304,031	...	296,902
Flax, ...	89,197	...	108,149
Clover and Grasses, . .	1,962,730	...	2,032,861
Permanent Pasture, . .	10,316,308	...	10,215,927

Few of even the moderate sized farms are entirely under tillage, and the extensive farms, especially in the western and some of the midland counties, are devoted exclusively to pasture, or have a small portion of arable attached to a large share of permanent pasture. The farm buildings are therefore suited to these circumstances, and present a marked contrast to English and Scotch steadings erected for farms of similar extent and fertility.

Dairy produce and live stock, consisting of cattle and swine and poultry, are exported from Ireland to an immense extent. The pig is an inmate of almost every peasant's cabin, is remarkably docile, and as carefully provided for as any member of the family.

The Census Commissioners of 1841 ascertained the quantity of land in every farm of Ireland, and the number of horses and mules, asses, cattle, sheep, pigs, and poultry on each holding in that year, and the returns published in their report afford a valuable basis for comparison. The commissioners assumed an average rate per head for each description of live stock, viz. horses and mules were valued at £8 each; asses at £1; horned cattle at £6 10s.; sheep at £1 2s.; pigs at £1 5s.; goats at 7s. 6d.; and poultry at 6d. The actual value of the different descriptions of live stock has very materially increased since 1841, so that the following table, comparing 1851, 1861, 1871, and 1881, with 1841, at the valuation rates of the latter year, is much under the mark. In 1881 it was estimated that the total value of Irish live stock was over £60,000,000.

LIVE STOCK.

	Horses and Mules, at £8 each.	£1 each.	£6 10s. each	Sheep, £1 2s. each	Pigs, £1 5s. each.		6d. each	
	£	£	£	£	£		£	£
1841	4,608,920	92,365	12,110,250	2,316,806	1,766,012		211 455	21,105,808
1851	4,346,496	136,981	19,288,497	2,334 311	1,356,071	88,242	186,767	27,737,395
1861	5,075,024	173,714	22,565,972	3,911,655	1,377,553	71,191	259,279	33,431,385
1871	4,458,656	180,204	25,825,162	4,651,591	2,020,867	87,335	291 576	37,515,211
1881	4,561,840	187,356	25,701,124	3,584,840	1,360,051	99,958	349,142	35,847,311

Botany.—Generally speaking, the botanical characteristics of Ireland are identical with those of Great Britain. The oak, however, does not flourish, and the principal trees are the birch, aspen, alder, willow, blackthorn, and elm.

Ireland once had the name of the Island of Woods, from being covered with forests, and latterly acquired the poetical name of the Emerald Isle, from the perennial brilliancy of its verdure. In 1884 Mr. Howitz, forest conservator to the Kingdom of Denmark, who had been requested to investigate the matter, reported strongly in favour of re-afforesting the waste lands of Ireland, believing that it would be easy to rear the most valuable timber trees, and that the work of re-afforesting would not only be a boon to the country at large, by preventing the flooding of the lowlands during heavy rains, and fertilizing them by a steady flow of water throughout the year (thus making the climate more congenial and healthy), but that it would have the great advantage of being an eminently remunerative undertaking. The flora of Ireland contains some rare varieties; the *Arbutus unedo* flourishes in Killarney; varieties of saxifrage and of ferns are found in the mountains of Kerry; Connemara, Benbulben Mountain in Sligo, and Antrim County, abound in scarce Alpine plants; rare and hitherto unknown species of Algæ have been discovered on various parts of the coast.

Zoology.—None of the larger carnivorous quadrupeds are found in Ireland, though the wolf and the bear were common up to a comparatively recent date. The fox is rare; and the badger and the otter are seldom met with, except in the neighbourhood of the Lakes of Killarney. The wild cat haunts the wooded districts, and two or three varieties of the weasel and marten occur.

The common squirrel has only recently been introduced. Of hares and rabbits numerous varieties exist, and in many localities their name is legion. The mole is not found in Ireland, and while it can boast of the red deer it lacks the roebuck. The fossil remains of a large species of deer, commonly known as the Irish elk, are frequently discovered in boggy localities. The golden eagle inhabits the wild mountainous districts. The elk, or moose deer, was a native of the country; its bones have been found in several places: wolves were once so numerous that a price was set upon them, and the Irish wolf-dog kept for hunting them. Venomous animals are unknown; the moisture of the climate is destructive to them. As is well known, from a tradition associated with St. Patrick, no snakes occur in Ireland; and the only reptiles which it possesses are a single species of lizard and four of the order of Batrachians.

Fisheries.—Bounties to encourage the fisheries of Ireland, granted in 1764, and continued for several years, failed to place them on a productive footing. The experiment was repeated in 1819, when commissioners were appointed, with power to grant bounties to persons building fishing boats of a certain tonnage, and for the curing of herring and some other kinds of fish. An annual sum of £5000 was placed at their disposal, the application of which was afterwards limited to the building of piers and the repairing of boats; a large portion of the grant was also employed as a loan fund, to enable the poorer fishermen to procure the necessary gear on advantageous terms. The commission was revoked in 1830, and no further measures were adopted respecting the fisheries until 1842, when the Board of Public Works were appointed commissioners for their improvement and regulation. The country is portioned out into thirty-two coast fishery districts, and seventeen salmon and inland fishery districts. The fishermen, especially those on the western coast, have never really recovered from the effects of the famine year, and for the most part still struggle against almost overwhelming obstacles to maintain themselves and their families. By far the larger proportion of the fishing population of Ireland are indeed chiefly occupied in other avocations. The collection of seaweed, or the tilling of land, either as occupiers of small holdings or as day labourers, occupies most of them during nine months of the year; for, though a brave and hardy race, it is impossible for them to venture out in their crazy craft in dirty weather. If it were pos-

sible to place them upon a more equal footing with their English fellows, so that they might prosecute their legitimate calling vigorously, and not spend arduous days in cultivating the sterile and unproductive soil, which is the proper name to give most of the Irish sea-board, they could easily be weaned from the evil influences of uncongenial and unprofitable agricultural pursuits, and removed from a state of extreme penury to one of comparative comfort. As it is, however, the poor Irish fisherman of Kerry, Clare, or Mayo may well be discontented. While he digs his unproductive land, he can see in the offing well-appointed English and French trawlers reaping that rich harvest which, but for his poverty, he could share. Great care is taken of the salmon fisheries, which improve every year, and are now estimated to be worth £400,000 per annum. The Irish markets are supplied with cured fish from Scotland and the Isle of Man.

Trade and Commerce.—The staple manufacture of Ireland is that of linen, which has long been established in the country, and to promote which has always been a favourite idea with the government. While in England the custom of burying the dead in woollen shrouds was adopted to aid the woollen manufacture, in Ireland the use of linen hatbands and scarfs at funerals was introduced for a similar purpose. Down to a recent date the fabric was produced in the cottages, where the peasant, in the intervals of agricultural labour, wove by the handloom the yarn spun by the female and younger members of his family, sometimes working on his own account, though more generally for masters. But this system has been entirely abandoned for factory labour, and at Belfast, Lurgan, and Donaghadee there are some of the largest and best conducted mills in the empire. The bulk of the native Irish are, however, by temperament averse to the restraint and continuous application which both the factory system and mining industry involve. The cotton manufacture is carried on to some extent in the same area. Coarse woollens and some fine broadcloths are produced at various places, with lace, embroidered muslin, and tabinets or poplins, a mixed fabric of silk and wool, the manufacture of which is almost entirely confined to Dublin. But except linen, all the other products fill but a limited space in the marts of the world, employ but a comparatively small amount of capital and labour, and in relation to manufactures Ireland stands low in the European scale.

The exportation of the agricultural produce of the country has always been the principal commercial business carried on in Ireland. During the revolutionary war the country furnished a large share of the provisions for the army and navy, and it still sends supplies to the colonial markets. But Great Britain is by far the best and most extensive market for all sorts of Irish produce. By much the greater part of the export trade is carried on by the cross-channel navigation, chiefly to Liverpool, Bristol, and Glasgow, the staple articles being black cattle, sheep, swine, salted provisions, grain, flour, butter, eggs, and linen. The trade with the colonies and with foreign parts is comparatively inconsiderable. The cessation of the collection of the duties on the cross-channel trade, which took place in 1825, has taken away the means of estimating the amounts of imports and exports to and from Great Britain since that period.

Political Divisions and Population.—Ireland is now divided into the four provinces of Leinster, Munster, Ulster, and Connaught, Meath being merged into Leinster and Ulster. These are subdivided into thirty-two counties, besides the eight small exempt jurisdictions of Dublin, Cork, Kilkenny, Limerick, Waterford, Drogheda, Carrickfergus, and Galway, the first five of which are styled counties of cities, the remaining three counties of towns. The counties are divided into 316 baronies, and again into 2422 parishes. Under the Poor Law Act the country is divided into 168 unions. The area of each county and its population in 1881 were as follows:—

Provinces and Counties.	Statute Acres.	Population.
Province of Leinster—		
Carlow County, .	221,344	46,568
Dublin " .	226,895	418,910
Kildare " . .	418,496	75,804
Kilkenny, " . .	509,732	99,531
King's " . .	493,985	72,852
Longford, " . .	269,409	61,009
Louth Co. and Co. of the town of Drogheda, . . .	202,123	77,684
Meath County, .	579,861	87,469
Queen's " .	424,854	73,124
Westmeath " .	453,453	71,798
Wexford " .	576,588	123,854
Wicklow "	500,178	70,386
Total of Leinster, . . .	4,876,918	1,278,989
Province of Munster-		
Clare County, . . .	827,994	141,457
Cork " . . .	1,849,686	495,607
Kerry " . . .	1,185,918	201,039
Limerick " . . .	680,842	180,632
Tipperary " . . .	1,061,731	199,612
Waterford " . . .	461,552	112,768
Total of Munster, . . .	6,067,723	1,331,115
Province of Ulster—		
Antrim County, . . .	762,080	421,943
Armagh "	328,086	163,177
Cavan	477,399	129,476
Donegal "	1,197,154	206,035
Down "	612,399	272,107
Fermanagh	457,369	84,879
Londonderry "	522,315	164,991
Monaghan "	319,741	102,748
Tyrone "	806,658	197,719
Total of Ulster, ...	5,483,201	1,743,075
Province of Connaught—		
Galway County, ...	1,569,505	242,005
Leitrim "	392,363	90,372
Mayo "	1,360,731	245,212
Roscommon "	607,691	132,490
Sligo "	461,796	111,578
Total of Connaught. . .	4,392,086	821,657
Total of Ireland, . . .	20,819,928	5,174,836

The population was divided as follows according to occupation in 1881:—

	Males.	Females.	Total.
Professional class, .	136,489	62,195	198,684
Domestic " . .	34,068	392,093	426,161
Commercial " . .	70,751	1,494	72,245
Agricultural " . .	902,010	95,946	997,956
Industrial " . .	428,578	262,931	691,509
Indefinite and non-productive, . .	961,381	1,826,900	2,788,281
Total, . . .	2,533,277	2,641,559	5,174,836

The number of inhabited houses at the census of 1881 was 914,108, against 961,380 in 1871, and 995,156 in 1861.

In 1881 there were only three cities with over 50,000 inhabitants—viz., Dublin, with 249,602, but 349,648 within the metropolitan police district (336,600 in 1871); Belfast, 208,122; Cork, 80,124; Limerick had 38,562 inhabitants; Londonderry, 29,162; Waterford, 22,457.

The returns for 1881 gave a density of population of 160 inhabitants per square mile, showing that Ireland was still almost as thickly populated as France and Germany. Of the population in 1881 there were 2,533,277 males and 2,641,559 females. The population of Ireland is now less than at the commencement of the century, as will be seen from the following table:—

Year.	Population.	Increase.	Decrease.
1801	5,395,456	—	—
1811	5,937,856	542,400	—
1821	6,801,827	863,971	—
1831	7,767,401	965,574	—
1834	7,954,100	186,699	—
1841	8,175,124	221,024	—
1851	6,552,385	—	1,622,739
1861	5,798,967	—	753,418
1871	5,412,377	—	386,590
1881	5,174,836	—	237,541

Banks.—Previously to 1783 the whole of the banking business was carried on by private individuals. The failure of many of these led to the establishment, in that year, of the Bank of Ireland, with similar privileges to the Bank of England, the most important of which was the restricting of all other banks to six partners each. In 1804 there were fifty private banks in Ireland, all of which have failed or wound up their accounts, except three in Dublin that continue to transact business. About that period the silver currency of the country, though generally in a debased state, became more valuable in the form of bullion, and was all melted down. The place of the coins was supplied in Dublin and many other parts by counterfeits; and in several districts by a paper currency, issued for sums decreasing from 6*s.* to 3*d.*, and even less. It is estimated that in 1804 there were 295 issuers of this paper money, chiefly merchants, shopkeepers, and petty dealers. The mischiefs arising from this system led at length to its suppression by law, and the wants of the trade were supplied by stamped dollars rated at 6*s.*, and by silver tokens of 10*d.* and 5*d.*, issued by the Bank of Ireland.

In 1821 the charter of the Bank of Ireland was renewed for seventeen years, and joint-stock banks were allowed to be established beyond 50 miles Irish from Dublin; but the arrangement was inoperative until several vexatious restrictions were repealed in 1824. This relief was followed by the institution of the Hibernian, Provincial, Northern, and some other banks, and the Bank of Ireland then began to establish branches in the country towns.

On the expiry of the Bank of Ireland's charter in 1838 it was continued by Act of Parliament from year to year until 1845, since which time it has been regulated by the new Banking Act, 8 & 9 Vict. c. 37, according to the following principles:—The bank to continue the banker of government. The proceedings of the establishment to be under the same rule which has been applied by Parliament to other banking institutions, and to make weekly returns, similar to those of the Bank of England under the new Act, containing a full development of its affairs, the amount of its bullion, and the variations in the quantity thereof. By the same Act any bank privileged to make and issue notes may relinquish this right in favour of the Bank of Ireland according to certain regulations, but such bank cannot resume the privilege. In Ireland one-pound bank notes are issued, but they are not a legal tender in England.

The Bank of Ireland was established in Dublin in 1783, with a capital of £600,000, enlarged at various times, and on the renewal of the charter in 1821 it was increased to £3,000,000 (Irish currency), of which £2,630,769 is lent to government at 3 per cent., producing an annual income to the bank of £78,923 10*s.* 6*d.* The yearly dividends to the stockholders have been at no time less than $5\frac{1}{2}$ per cent., except in 1783–84, when they were paid 5, and in 1792–93 $2\frac{3}{8}$ per cent. From 1800 to 1814 they were 7, $7\frac{1}{4}$, and $7\frac{1}{2}$; from 1814 to 1829, 10 per cent. excepting two years; and since 1829 the rates have varied from 8 to $13\frac{1}{2}$ per cent. Besides these dividends the proprietors at different times have received bonuses amounting to £800,000.

Railways and Canals.—The chief features of the railway system in Ireland are—1st, the gauge, which is 5 feet 3 inches, and is compulsory; 2nd, the moderate cost of the works generally, and a singular and almost entire freedom from tunnels. Notwithstanding this, and in spite also of the fact that the lines are exempt from passenger duty, the average earnings of the Irish railways do not amount to as much as $6\frac{3}{4}$ per cent., and from various causes the working expenses are very high. Indeed, more than a fourth of the Irish lines do not pay interest even upon the loan capital expended on them; and so unsatisfactory was the whole matter that in 1868 a royal commission was appointed to investigate it, and in their report, issued in the following year, they recommended that the government should purchase and work the lines, thereby effecting a great saving by placing the whole of the debenture capital and other borrowed money under government guarantee, and by the concentration of management and the more profitable use of stock. They also recommended that the fares should be uniformly reduced to $1\frac{1}{4}d.$ per mile first class; $\frac{3}{4}d.$ second; and $\frac{1}{2}d.$ third. Their recommendations have not yet been adopted, but they believed that if they were, at the expiration of eleven years the receipts from increased traffic would be of sufficient amount to pay all working charges, cost of increased rolling stock, siding and other accommodation, interest on borrowed money, and interest on capital advanced to meet losses during the period, and leave a balance in favour of the exchequer.

The principal canals of Ireland are the Royal Canal, commenced in 1789, from Dublin to Tarmonbarry, on the Shannon, with a branch from Killashee to Longford—total length, 97 miles. The Grand Canal, commenced in 1765, from Dublin to the Shannon at Shannon harbour. It has several branches. The length of the main trunk, from the Liffey to the Shannon, is 80 miles, and thence to Ballinasloe 15 miles, being 95 miles in a western direction; that of all the branches is $65\frac{3}{4}$; total length, $160\frac{3}{4}$. The Ulster Canal proceeds from Charlemont, on the Blackwater River, by which it communicates with Lough Neagh, and passing by Monaghan and Clones, enters the upper Lough Erne. Its length is 48 miles. The Shannon navigation, by far the most important system of inland water carriage in Ireland, is described in the article SHANNON.

Government.—The executive government is vested in a lord lieutenant, assisted by a privy council, appointed by the crown and indefinite in number, forming the body popularly denominated *the Castle*, the lord lieutenant having his official residence in Dublin Castle; and a chief secretary of state is also allotted to Ireland, who is always a member of the House of Commons. In the absence or vacancy of the lord lieutenant his place is supplied by lords-justices, who generally are the lord chancellor and the commander of the forces. Each county is in charge of a lord lieutenant, generally a peer, an indefinite number

of deputy lieutenants and magistrates, who act gratuitously, and one or more resident paid magistrates, all appointed by the crown during pleasure.

The counties of cities and towns and the boroughs are governed by their own magistrates. Important improvements in the local legislation of Ireland were made by an Act passed in 1872. By this Act many of the privileges claimed by the Home Rule party were in fact obtained, and have been exercised to no small extent. Numerous districts have obtained permission to take the management of local matters into their own hands, to get rid of the control of the grand juries, to enlarge their boundaries, purchase lands, widen streets, and construct various works of public utility and improvement.

The inhabitants of Ireland have shown the greatest aptitude for local government and the administration of local taxation. Many reforms in these respects proposed for England have long been carried out in Ireland. Turnpike tolls, for instance, were abolished so far back as 1857, and 47,000 miles of good roads are maintained entirely toll-free. Their expense is borne by local taxation, which, however, is much less in amount than that of England. The chief item of imperial revenue is the duty on home-made spirits, amounting to about £3,500,000 annually. Ireland pays neither land nor assessed taxes.

The country is represented in the imperial Parliament by twenty-eight temporal peers and 103 members of the House of Commons.

Religion.—Ireland is essentially a Roman Catholic country, and the fact that the former Protestant Established Church in Ireland was that of such a small minority of the population, had for a very long period caused much ill-feeling and dissatisfaction, and ultimately resulted in the passing of the celebrated Irish Church Act, the history and chief provisions of which are described below, and which came into operation on the 1st of January, 1871.

The following table shows the religious beliefs of the people in 1871 and 1881:—

RELIGIOUS PROFESSIONS.

Provinces.	Roman Catholics.		Returned as of the Church of Ireland, of the Irish Church, and as Protestant Episcopalians.		Presbyterians and Methodists.		All other Persuasions.		Jews.	
	1871.	1881.	1871	1881.	1871.	1881.	1871.	1881.	1871	1881.
Leinster, .	1,145,104	1,095,459	164,586	157,622	19,086	19,345	10,457	6,090	218	333
Munster, .	1,304,684	1,244,876	74,213	68,352	8,849	8,215	5,730	2,337	9	33
Ulster,. .	897,230	831,784	393,268	377,936	507,632	500,601	35,040	28,477	58	77
Connaught,	803,849	779,769	35,931	31,760	5,522	5,011	911	608	—	10
Total, .	4,150,867	3,951,888	667,998	635,670	541,089	533,172	52,138	37,512	285	453
	Decrease.		Decrease.		Decrease.		Decrease.		Increase.	
	198,979		32,328		7,917		14,626		168	
Rate per cent.,	4·8		4·8		1·5		28·1		58·9	

From this table we learn that on the night of the 3rd of April. 1881, the members of the Roman Catholic Church in Ireland amounted to 3,951,888; those returning themselves as belonging to the Church of Ireland or Irish Church to 578,593; and as Protestant Episcopalians to 57,077. These two together represent the denomination of the late Established Church, and amount to 635,670. Presbyterians numbered 485,503; Methodists, 47,669; Independents, 6014; Baptists, 4894; and the Society of Friends, 3696. The number of Jews was 453. Of the total population in this year 76·6 per cent. were returned as Roman Catholics; 12·3 per cent. as Protestant Episcopalians; 9·4 per cent. as Presbyterians; and 0·9 per cent. as Methodists.

The Roman Catholic hierarchy consists of four archbishops (whose sees are in Armagh, Dublin, Cashel, and Tuam) and twenty-four bishops. [See BISHOPRIC.] The bishops are nominated by the pope, generally from a list of names submitted to him by the bishops of the province and the clergy of the vacant diocese. In case of expected incapacity from age or infirmity, the bishop names a coadjutor, who is usually confirmed by the pope. Every diocese has a dean and an archdeacon, the former appointed by the cardinal protector at Rome, the latter by the bishop; but these dignities are without jurisdiction or emolument. The whole of the clergy are supported solely by the voluntary contributions of their flocks. The episcopal emoluments arise from the parish in which the bishop officiates, from marriage licenses, and from the cathedraticum, an annual sum varying from £1 to £10, paid by each incumbent in the diocese. The parochial clergy are nominated exclusively by the bishop. The incomes of the priests arise from fees on marriages, baptisms, and deaths, from Easter and Christmas dues, and from incidental voluntary contributions, either in money or labour. All the places of public worship are built by subscription. There are numerous monasteries and convents; the latter are supported partly by sums, usually from £300 to £500, paid by those who take the vows in them, and partly by the fees paid for the education of their daughters by respectable Roman Catholics. The friars and nuns also devote themselves to the gratuitous education of the children of the poor. Candidates for clerical ordination, formerly under the necessity of obtaining their education in continental colleges, are now educated at home. The principal clerical college is that of St. Patrick, Maynooth. It was formerly supported by grants of public money, but under the Irish Church Act these were commuted for £400,000.

The Protestant Episcopal Churches of England and Ireland were united by the Act of Union in 1800. For some years after a severe battle was fought in Parliament on the question of the admission of Roman Catholics to sit and vote in either House, which was at last conceded by the Emancipation Act of 1829. In 1834 Mr. Ward, the member for St. Albans, moved a resolution to the effect that the Protestant establishment in Ireland exceeded the wants of the population, and that as it was the right of the state to regulate the distribution of church property, it was the opinion of the House that the temporal possessions of the Irish Church should be reduced. The government of Lord Grey (after four of its leading members—the Duke of Richmond, the Earl of Ripon, Sir James Graham, and Mr. Stanley—had resigned on the subject) proposed to issue a commission of inquiry; but this did

not satisfy Mr. Ward, who persisted in dividing the House. He was, however, defeated by 396 to 120. The subject was also discussed with much warmth in the House of Lords. The Melbourne ministry, which succeeded that of Earl Grey in July, was dissolved in the November following, and the Duke of Wellington and Sir Robert Peel having succeeded to power, the Irish Church was made the point of attack by their opponents; and on 30th March, 1835, Lord John Russell moved in the House of Commons —"That the House do resolve itself into a committee to consider the temporalities of the Church of Ireland." The motion was strongly resisted by the ministers, but was ultimately carried by 352 to 289, after a debate extending over four nights. The House, accordingly, at once resolved itself into a committee, and Lord John Russell submitted a resolution embodying the well-known appropriation principle, to the effect that any surplus of the revenues of the church not required for the spiritual care of its members, should be applied to the general education of the people, without religious distinction. This resolution was carried by 262 to 237; and on the following day Lord John Russell moved, "That no measure upon the subject of tithes in Ireland can lead to a satisfactory and final adjustment which does not embody the principle contained in the foregoing resolution." This strong confirmation of the appropriation principle was carried by 285 to 258, and the ministry at once resigned. The bills brought forward by their successors, embodying the appropriation principle, were amended by the House of Lords, which invariably rejected the clause, and in 1838 the ministers abandoned it and carried the Irish Tithes Composition Act. From that time occasional attacks on the church were defeated; but in 1867 a motion made by Sir John Gray, and pledging the House to take into consideration the privileges and temporalities of the church, with the view to remove anomalies, was only defeated by a majority of twelve—195 to 183. In the same year Earl Russell moved in the House of Lords for the appointment of a commission to inquire into the revenues of the Established Church, with a view to their more equitable application, but the motion was rejected by ninety to thirty-eight. The government (that of Lord Derby), however, appointed a commission, after having limited its power so far that in any recommendation made as to the redistribution of its revenues the church alone was to be considered. Early in the session of 1868 Mr. Maguire moved for a committee on the state of Ireland, and in the closing night of the debate on that subject Mr. Gladstone, the leader of the Opposition, said the time had arrived when the church in Ireland must cease to exist as a state institution, as it included less than one-eighth of the population. A week later he submitted resolutions to this effect, which were carried by a majority of sixty—330 to 270. In consequence of this he brought in a Suspension Bill, with the view of preventing any appointments being made in the church during the next twelve months. This was carried triumphantly through the Commons, but rejected in the Lords by ninety-five—192 to ninety-seven. A general election took place in November; and a large majority having been returned to support Mr. Gladstone's policy, the government of Mr. Disraeli (who had succeeded Lord Derby) resigned without meeting Parliament, and Mr. Gladstone was intrusted with the task of forming an administration, with the avowed purpose of disendowing and disestablishing the Irish Church. Parliament met on the 16th of February, 1869, and on 1st March Mr. Gladstone introduced his bill. Its chief proposals were so framed as to conciliate a large number of important interests. The church was left unfettered to form itself into a new body, but the state was to decide whether this body was sufficiently representative; the landlords were to be freed for ever from the tithe rent-charge in forty-five (afterwards extended to fifty-two) years; the tenants were to be relieved of a large portion of the county cess; the Roman Catholic College at Maynooth and the Presbyterians were to be handsomely provided for; while the British taxpayer was to be relieved of over £70,000 a year which had formerly been paid for the support of the college and as *Regium Donum* to the Presbyterians. Even the church, although it was to be really disestablished and disendowed —for those were the chief features of the bill—was to keep all its churches, on the ground that they were unmarketable; it was also to retain its glebe houses at much less than their value, and all its private endowments since 1660. The surplus of the church revenues was to be spent in the amelioration of the lot of the afflicted, such as the blind, deaf and dumb, and insane. The measure was carried without important alteration, and came into operation on 1st January, 1871, on which date the union of the Church of Ireland with that of England came to an end; the entire mass of church property passed to commissioners appointed for the purpose; every ecclesiastical corporation was dissolved; and the church was relegated to the position of a voluntary religious association, possessed of absolute liberty to define its own doctrines and manage its own affairs.

The sacrifice of endowments, whereby the church acquired the right to manage its own affairs, was doubtless a heavy price to pay; but a few years' experience showed there was no lack of private munificence to supply every need. The new constitution of the church, agreed upon in 1870, provided for the appointment of two churchwardens in each parish. There is a vestry composed of all the male members of the congregation, who elect from their own body a number of communicants, not less than three nor more than ten, who, with the incumbent, curate, and churchwardens, form a select vestry. This smaller body has charge and control over church funds, provides the requisites for church service, keeps the buildings in repair, and appoints and controls all church officers and servants. The select vestry is subject to the diocesan synod, which consists of the bishop, the incumbents and curates, and of at least one synodsman elected from each parish in the diocese. The diocesan synod meets annually, the bishops, clergy, and laity debating and voting together. Above the diocesan synod is the general synod, consisting of the two houses of bishops and representatives, the latter embracing 100 representatives of the clergy and 150 of the laity. The general synod meets triennially, and forms the supreme legislative and administrative authority of the church. Besides these there are committees of patronage, a board of patronage, and a final court of appeal.

In 1874 a resolution was passed by the general synod confining the reading of the Athanasian Creed to Christmas Day, Whit-Sunday, and Trinity Sunday, and omitting the first, second, third, twenty-eighth, twenty-ninth, and part of the thirtieth and forty-second verses. From the communion service several sentences quoted from the apocryphal book of Tobit were cut out; "damnation" was altered to "condemnation;" the words "standing at the north side of the table" were introduced; a declaration was also affirmed by resolution to the effect that the "teaching is not permitted by the Church of Ireland that there is in, or under the form of, the elements a presence of Christ or of Christ's flesh and blood, unto which adoration may or ought to be done."

In 1885 the church body had over £7,000,000 in hand, derived chiefly from the following sources:—(1) Upwards of £2,500,000, the balance of the commutation money received to pay the annuities of the clergy, charged with annuities amounting to £180,000 a year; (2) £500,000 received in lieu of private endowments; (3) nearly £1,500,000 derived from the composition of annuitants; (4) upwards of £2,500,000 voluntarily contributed by friends of the church since its disestablishment. The

surplus accruing to the state from the disestablishment of the church was about £6,500,000. The Act 41 & 42 Vict. c. 66 appropriated £1,000,000 of this amount for purposes of intermediate education in Ireland; the National School Teachers (Ireland) Act, 1879, provided that £1,300,000 sterling should be applied to form a pension fund for the teachers of national schools in Ireland; and the Relief of Distress Acts, 1880, provided for advances not exceeding £1,500,000 for distress works. In 1881 £20,000 a year was appropriated for the purpose of maintaining the Royal University of Ireland (equivalent to a further capital sum of about £600,000), and advances have also been sanctioned by Parliament, under the Land Law (Ireland) Act, as loans to enable arrears of rent to be paid to landlords.

The Presbyterians, who are found chiefly in Ulster, are formed into congregations, each of which is under the ecclesiastical government of a court called a session, consisting of the minister and elders of the congregation. An indefinite number of the ministers of these congregations, with a lay elder for each, constitutes a presbytery, which has the charge of the congregations represented in it. Delegates from each of these presbyteries, consisting of all the ministers, with a lay elder for each, constitute the General Assembly, which is presided over by a moderator chosen annually, and regulates the ecclesiastical concerns of the body. The General Assembly of the Presbyterian Church in Ireland consists of forty presbyteries, which comprise 640 ministers (besides forty licentiates and ministers without charges) and 560 congregations. The ministers are supported by voluntary contributions, the rents of seats or pews, and the proceeds of the commutation of the annual parliamentary grant called the *Regium Donum*, or royal gift, first granted in 1672 by Charles II., who gave £600 of secret service money to be distributed in equal portions among them annually. The grant was discontinued towards the close of his reign and during that of James II., but was renewed by William III., who augmented it to £1200 a year. In 1784 it was increased to £2200, in 1792 to £5000, and in 1803 a classification was made according to the number of families in each congregation and the amount of the minister's voluntary stipend. The total annual amount on this arrangement was about £40,000; and the sum paid in commutation by the Irish Church Commissioners was £800,000.

Universities and Education.—Trinity College, Dublin, incorporated by charter or letters patent, 34 Eliz. (1591), is the most important educational foundation in Ireland. The dissolved monastery of All Hallows in Hoggins, now College Green (then in the eastern suburbs of the city), was given by the corporation of Dublin as a site upon which to build it. In the charter of foundation the queen nominated one provost, three fellows, *nomine plurium*, and three scholars, *nomine plurium*, to constitute with their successors for ever a body corporate and politic, under the name of the provost, fellows, and scholars of the College of the Holy and Undivided Trinity of Queen Elizabeth, near Dublin. The number of the corporation has been increased from time to time, and at present consists of a provost, seven senior fellows, twenty-six junior fellows, and seventy scholars. The system of instruction is superintended by the fellows both senior and junior, together with a number of professors in the various departments of science and literature. The course extends over four years, the principal studies of each year being successively mathematics, logic, natural philosophy and astronomy, and ethics. A medical school has been long attached to the university, to which has lately been added a school of civil engineering: and degrees and licenses in surgery and civil engineering are granted by the university senate on the completion of the prescribed courses. The college possesses a fine library of about 160,000 printed volumes and 1700 manuscripts; and the number is increased annually by about 1500 volumes, which are partly purchased and partly obtained under the Copyright Act; also a well-stocked botanic garden and a museum. The buildings, which include a large extent of ground, now nearly in the middle of the city, consist of one very large and two smaller squares; in these are the chapel, the theatre for examinations, the museum, the library, the dining hall, the printing office, and chambers for the fellows and students. Attached to the buildings is a large space planted for the recreation of the students, and a smaller inclosure for the provost and fellows. The average number of students on the books of Trinity College is 1100, and the number of students entering in each year is about 280. By an Act passed in 1873, known as Fawcett's Act, tests were abolished, and the prizes and honours of all grades previously reserved for Protestants were thrown open to all. Examinations for women are now held under the direction of the college.

The Royal University of Ireland.—By her Majesty's letters patent, bearing date the 27th April, 1880, a university was founded in pursuance of the provisions of the University Education (Ireland) Act, 1879, under the style and title of the Royal University of Ireland, which has since 1882 superseded the former Queen's University in Ireland, it having been provided that the graduates and students of the latter university should have similar rank in the new university. The newly established university corporation consists of a chancellor, a senate, and graduates. The government of the university is vested in a senate consisting of the chancellor and senators, the senators not to exceed thirty-six in number, with power to grant all such degrees or other distinctions as can be conferred by any university of the United Kingdom, except in theology. The charter gives power to confer such degrees upon all male or female students who shall have matriculated in the university and passed the requisite examinations prescribed by the senate, and provides that no residence in any college, nor attendance at lectures or any other course of instruction in the university, shall be obligatory upon any candidate for a degree, other than a degree in medicine or surgery. These privileges are the same as those hitherto in force in the London University. The Act 44 and 45 Vict. c. 52, provides for the payment of £20,000 a year out of the surplus funds of the Irish Church for the purposes of the university.

Queen's Colleges.—Under the Act 8 & 9 Vict. c. 66, passed in 1845, for establishing new colleges in Ireland, three colleges, called Queen's College, Belfast; Queen's College, Cork; and Queen's College, Galway, were established by Sir Robert Peel in 1849, at a cost of £100,000, and statutes issued for their government. Collectively with the central Dublin establishment these constituted the Queen's University in Ireland. New charters, amending the former ones, passed the great seal in 1863. So far as the university was concerned it was disestablished in 1882; but the colleges continue to flourish, and form part of the Royal University of Ireland. Candidates for the degree of bachelor in arts now attend the Queen's Colleges for three sessions, and undergo two examinations in the Royal University of Ireland.

Board of National Education.—In 1831 the grants of public money for the education of the poor were intrusted to the charge of the lord lieutenant, to be expended on the instruction of the children of every religious denomination, under the superintendence of commissioners appointed by the crown, and named the Commissioners of National Education. The principles on which the commissioners act are, that the schools shall be open alike to Christians of every denomination; that no pupil shall be required to attend at any religious exercise, or to receive any religious instruction which his parents or guardians do

not approve, and that sufficient opportunity shall be afforded to the pupils of each religious persuasion to receive separately, at appointed times, such religious instruction as their parents or guardians think proper. This system of united education is one which does not exclude children of any denomination, while it admits to a participation of its benefits those of every religious creed who may wish for instruction without interfering with any conscientious scruples. The duty of the commissioners consists, therefore, in guarding against any infraction of these fundamental principles from any quarter; in establishing regulations as to details, so as best to secure the general efficiency of the system; and in granting or refusing assistance to every applicant for erecting and maintaining suitable buildings for schools, and for furnishing them with books and other requisites.

In 1845 the commissioners were incorporated under the name of the Commissioners of National Education in Ireland, with power to hold lands to the yearly value of £40,000, to receive gifts and bequests to that amount, to purchase goods and chattels, to erect and maintain schools where and as many as they shall think proper, to grant leases for three lives or thirty-one years, to sue and to be sued by their corporate name in all courts, and to have a common seal, a power being vested in the lord lieutenant to fill up vacancies, to appoint additional members provided the total number does not exceed twenty, and to remove members at his pleasure. The commissioners being enabled, under this charter, to accept conveyances of property in their corporate capacity, have resolved, in case of making a grant for building a national school-house, to take upon themselves the trust for the public and the charge of repairs; leaving the local managers, who in general are not the trustees, the rights they now possess as to the appointment and removal of teachers, and the general regulation of the school. In 1885 there were 8050 schools, with 1,100,000 pupils on the register, 870,000 of whom were Roman Catholics. The parliamentary grant amounts to £750,000 per annum.

Intermediate Education.—In 1878 a sum of £1,000,000, part of the Irish Church surplus, was set apart for the promotion of the intermediate secular education of boys and girls in Ireland. The administration of this fund is intrusted to a board of commissioners, who apply its revenue by (1) carrying on a system of public examinations; (2) awarding prizes, exhibitions, and certificates to students; and (3) by paying results fees to the managers of schools fulfilling certain prescribed conditions as regards their students and schools.

Judicial Divisions and Criminal and Pauper Statistics.—The judicial establishment of Ireland is now fixed by the Supreme Court of Judicature (Ireland) Act, 40 & 41 Vict. c. 57, passed 1877, which constituted and amalgamated the High Court of Chancery, the Court of Queen's Bench, the Court of Common Pleas, the Court of Exchequer, the Courts of Probate and of Matrimonial Causes and Matters, and the Landed Estates Court, into one Supreme Court of Judicature, under the name of Her Majesty's High Court of Justice in Ireland, which should exercise original jurisdiction, with appellate jurisdiction from inferior courts, and constituted another division under the name of Her Majesty's Court of Appeal in Ireland, which exercises such appellate jurisdiction as may be incident to the determination of any appeal.

There is a chairman of quarter sessions for each county, the county of Cork having two. The superior courts are held in Dublin; their terms of sitting are Hilary, Easter, Trinity, and Michaelmas. Two of the judges hold assizes for criminal and civil pleas in each county, in spring and summer every year, for which purpose the country is divided into six circuits. Two of the judges also hold a general gaol delivery for Dublin every six weeks.

The decrease in the number of criminals in Ireland during the last fifteen years has been very great, and in regard to heinous crime Ireland compares favourably with England, the number of offences being one-third less in proportion to the population; she also compares favourably with England in the number of cases of theft and of brutal offences against women and children, but very unfavourably in cases of malicious destruction of property, common assaults, and drunkenness. Of ordinary criminals about 60 per cent. are habitual, and this notwithstanding Sir Walter Crofton's excellent system of prison discipline, which prepares men for liberty and an honest life by a gradual emancipation earned by their own good conduct.

In the matter of pauperism, also, the improvement of the country is very clearly proved by the returns. At the time of taking the census in 1851 there were no less than 250,611 paupers in the Irish workhouses, and 47,019 persons in hospital, of whom 4545 were not workhouse inmates; in 1881 the numbers in workhouses, healthy and sick, were but 55,304. The number of out-door paupers at the same time was 53,688, making a total of 109,655.

The constabulary of Ireland is very efficient. The force consists altogether of about 13,000 men. with 400 horses. The Irish police are all armed, and are in reality semi-soldiers. In fact, by some it is held that the military element in the composition of the force is so strong as to somewhat detract from its usefulness for ordinary police purposes.

Antiquities.—Highly interesting remains of antiquity abound on the surface, as cromlechs, cairns, and pillar-stones, while the peat-bogs have yielded bronze swords, spear-heads of the same mixed metal, rings composed of it or of gold, the weapons, money, and ornaments of the old Celts. It is a remarkable fact that a greater number and variety of antique golden articles of remote age have been found in Ireland than in any other part of Northern Europe; and the majority of the gold antiquities illustrative of British history now preserved in the British Museum are Irish. The cromlechs, though varying in form and size, consist generally of three upright stones, which support a horizontal slab, and form a kind of rude chamber devoted to a sepulchral purpose; that of New Grange is entered by a passage so low that the person entering must draw himself in by his hands, pushing with his feet; inside the tallest man may stand upright. The cairns are piles of stones, forming artificial high places, on the flat tops of which fires were lighted on the festival of the sun-god and other special occasions, while all domestic fires were put out, and only rekindled from the sacred flame. Pillar-stones, both standing singly and in company, or arranged in circles, are believed to have been associated with forms of pagan worship; and hence the phrase of "going to the stone" was in common use in after-times for going to church or chapel. But by far the most remarkable monuments are the round towers. These are tall and slender circular buildings, terminating, when perfect, in a conical roof, with four small windows near the top, generally looking to the cardinal points. There are 118 of these singular structures in different parts of the island, but of several only the foundations remain. Eighteen are entire, or nearly so, and retain the conical summit. They are invariably found near the remains of churches, varying in height from 30 to 120 feet. Their object, after having given rise to endless speculation, still remains an unsolved problem. Ruins of churches of very early date are numerous, small, low, stone-roofed, and of great strength, with the peculiarity of the crypts being placed above, instead of under them; and fine remains of abbeys and monasteries are extant. Small castles, some perfect, others in various stages of decay, are profusely distributed. They are usually high square buildings, with towers at each corner, raised to restrain the wild Irish in the times of King John

and those of Elizabeth. Some palatial strongholds of earlier date are in good preservation, and still inhabited.

HISTORY.—Surely few peoples could, up to the present time, show a more unhappy history than the Irish. Any fair-minded "Saxon" going over the long list of misfortunes and injuries must feel shame for what his ancestors have done in the land, and will cease to wonder at Irishmen in their rage flinging fair dealing to the winds and girding up their loins in an impotent attempt at revenge. That they should punish people who never harmed them and only wish them well is certainly to be deplored. Happily the elements of union now exist, the deep-rooted antipathy shown in savage hate on the one side, and in open or half-concealed contempt on the other, is swiftly becoming a thing of the past; and Ireland has a great and a happy future at last possible to her. At the same time, in order to bear with the occasionally trying behaviour of Irish politicians, an acquaintance with the past of Ireland is necessary. Unhappily, the average Englishman but too often neglects it. Even before the advent of man Ireland's misfortunes may be said to begin. The main part of the country is a stupendous mass of carboniferous limestone, and there seems every reason to believe that this was overlaid in natural sequence by coal-measures. Certainly, if this were so, here was the most magnificent coalfield in the world; and further, there was plenty of iron ore distributed about it. The same elements of coal associated with iron have made England's fortune, but alas for poor Ireland, the melancholy ocean swept away these deposits, or perhaps, and indeed more probably, aerial denudation performed that cruel task. The immense stores of iron remain yet, but the coal is found only in a few isolated patches which have escaped destruction. Little attempt, we might almost say no attempt, has been made to realize these riches of the land.

The earliest history of Ireland is a mass of myth and legend, from which it is extremely difficult to get any historical facts; nor is it possible to present so multifarious a collection in a connected form, although, as in the Greek mythology, there is a certain consistency preserved. Ancient Ireland was split up into tribes, each with its hereditary bards, and doubtless the legends of past glories lost nothing in such hands as the years rolled on. Then came Christianity with its patient monkish chroniclers, and the ancient traditions were collected and written down, and by about the year 1000 all the gaps had been filled up, and the chroniclers had contrived to fit in the history of the Irish tribes with the history of the rest of the world. Such a work, as far as Munster was concerned, was the famous lost "Psalter of Cashel," compiled about the year 900 by Cormac MacCuileanan, king of Munster and archbishop of Cashel. Keating in his history (seventeenth century) used copies of this work which have since perished. The word psalter here means collection of lays, not necessarily of sacred lays or psalms. It stands for the Irish word *saltain*. Other ancient Celtic MSS., fortunately preserved, and still available as sources of history (such as it is) are the "Seanghus Mor," the great repository of the Brehon Laws; the "Book of Armagh" (807 A.D.), containing the Confession of St. Patrick, &c.; the "Leour na Heery" (Leabhar na h-uuidhre), a composition of the fifth century, preserved to us in a MS. of the eleventh century, and containing fragments of the "Iliad of Ireland." This is the "Tawin-bo-Quilgny" (Tain bo' cuailgne) or Quest of the Bull, probably of the most ancient bardic era, describing an armed expedition by the Queen of Connaught against Louth in quest of a certain dun red bull, which was crowned with triumph after great difficulties. Books of Leinster, of Ulster, of Orgial, &c., and Annals, as those of Teernah (died in 1088), of Giraldus Cambrensis, of the Four Masters (the Franciscan friars' work), of Innisfallen, of Boyle, &c., bring us down to fairly historic times. In fact there is a great deal of very ancient material for the history of Ireland, but it is of a kind needing the greatest patience and care to make good use of.

Ethnology agrees with early scattered notices in the ancient records that the aboriginal inhabitants of Ireland were of that mysterious race which still survives in Biscay, Liguria, and parts of Spain, the Ligures of Italy, the Aquitani of France, and the Iberi of Spain, a non-Aryan folk which was spoken of in the articles FRANCE and GAUL; a small, thin, dark-eyed, dark-haired people, in whom some observers think to trace Turanian elements. These were conquered by successive invasions of Celts, large-limbed, red-haired, blue-eyed, powerful warriors. (1) We are told of a Queen Casir (Ceasair), a niece of Noah, heading such an invasion, but we may safely set that to the credit of the bardic imagination. (2) Then we have a descendant of Japheth, Partholon, with a Greek conquest lasting in all 300 years. The invaders died off in a plague, and their plague-grave or tamlecht is the Tallaght near Dublin. This undoubtedly records a Celtic invasion of bronze-armed warriors from the East. (Everything from the East is set down vaguely as "Greek" in these early legends.) Many authorities regard them as the Picts. (3) The next cycle given us by the ancient records is that of a sea-folk who arrived under Nemed (*Neimiodh*), also said to be descended from Japheth, and we are told that these people conquered and settled along the coast. Later sea-warriors, called Fomorians (*Fomoraig*), arrived from Africa, which of course merely means from the south, and gained dominion over the Nemidians. (4) The mist seems to clear a little when we come to the Fir-Bolgs, who came from "Greece," that is, from the east, in several parties, much as the English came to Britain later on. The Fir-Galeons, the Fir-Domnands, the Fir-Bolgs, &c., conquered their new lands separately, the latter giving the name to the whole invasion. These tribes were British Celts. (5) Hardly had the Fir-Bolgs begun to settle down in their new home when the Tuadha-de-Danann burst upon the land from Scandinavia, fought the great Fir-Bolg prince, MacEire, conquered him, and exterminated his people. This last statement is absurd, because in St. Patrick's time we know very well that the Fir-Bolgs still formed the bulk of the population. The Tuatha also conquered the coast settlers, the Fomorians. (6) Finally, there was the Spanish or Iberian invasion, which touches the borders of history, the date, 1499 B.C., which is given to it being doubtless of exaggerated antiquity. This was the conquest by the Clan Milly, so called from their founder Miliodh or Milesius, who married Scota, daughter of Pharaoh, king of Egypt. Hence the Irish are called Milesians very frequently. Those invaders who came from the direction of Spain were also Celtic, and their name of Scots gave Ireland its first historic name of Scotia. (The native name *Eire* means "west" or "uttermost" (*ultima*), and its genitive *Eirean* gives the land its second name of *Erin*, musical and beloved of poets. Of the classic writers Aristotle, fourth century B.C., calls it *Ierne*, because of a tribe of *Ierni* who held a large part of the middle and south-west of the island. Julius Cæsar, first century B.C., calls it *Hibernia;* Juvenal, *Juvernia.*) These Scot chieftains partitioned Ireland into five parts, the well-known Ulster, Leinster, Munster, and Olnegmacht or Connaught; Munster making two of the parts. It is quite unnecessary here to enumerate the endless series of quarrels arising naturally from such a state of the country as has been depicted. Early in the Christian era the various races of Ireland combined to overthrow the dominant Scots or Milesians, but the issue of the fierce struggle was the rise of the central Milesian kingdom of Meath, which *Tuathal* or Toole made out of parts of all the four kingdoms so as to form the independent domain of the overking. For further support of the supreme authority he instituted a standing army or militia, the Fianna Eireann, or, as they are shortly

called, the Fenians. The King of Ireland (the Ard-Rig) had his capital at Teawair (Tara), where a triennial assembly of druids, kings, and chiefs met to settle the laws of all Ireland, and the national archives were drawn up as the "Psalter of Teawair." The site of Tara's Halls lies about 5 miles from Bective, Meath; the concentric earthen ramparts which defended the royal dwellings can yet be traced. The diameter of one of these rings (the Fortress of the Kings) is 853 feet. The buildings being of wood have in all probability left not a single trace.

In the whirl of this dim confused time, the elucidation of which belongs to antiquarian works rather than to these columns, we note a few names which are familiar in song and legend. Such are Feidhlim (Phelim) the lawgiver, about 164 A.D., and his son Conn Cead Cathac (Conn of the Hundred Fights), who divided all Ireland with the King of Leinster into Conn's half (Leath-chuinn) and Mogha's half (Leath-Mhogha). A grandson of Conn, Cairbre Riada, led one of the early colonies of Scots over to Caledonia (Scotland) about 200 A.D. and founded a Scottish kingdom in what is now Argyleshire. It must not be forgotten that Scot is a name confined to Scotia or Ireland at this time. Another grandson of Conn was even a greater man. This was the famous Cormac, who from 227 to 266 laboured first as a most successful monarch, then having become blind, and also turned from Druidism to Christianity and abdicated the throne, as a lawgiver and missionary. His "Laws" and the "Instructions for a King" were read for centuries at the enthronement of Irish princes. In this period Fionn MacCumaill (Fingal) and his son Oisin (Ossian) were the two most distinguished warriors and poets of the "Fenians." These are the heroes of the ancient Ossianic poems upon which Macpherson founded the so-called epics which Dr. Johnson so justly exposed in their falsity. Unhappily Macpherson, in his eagerness to help a bad case, destroyed or refused to produce the valuable materials on which he had so unwarrantably worked. From 350 to 400 the Irish kings made rapid raids upon Britain, Gaul, &c. The founder of the Niall or O'Neil family was slain at Boulogne, his successor at the foot of the Alps, and so forth. As we have now to pass to Christian Ireland a brief review of the life in pagan Ireland may be desirable.

As to religion the Druids held chief sway. Irish Druidism is alleged by the bards to be the original form, and the famous British Druid college of Mona (Anglesey) to have been planted by Irish priests. The yew, not the oak, was the sacred tree in Ireland under the Druids, and the rowan, the sloe, and the hawthorn were each venerated in certain magic rites. The Irish Druids offered no human sacrifices; their medical knowledge, their maintenance of the sacred everlasting fire, whence each man's hearth was kindled, their literary power, and their claims to prophecy and magic lent to them sufficient awe. Their writing, in the so-called Ogham characters, is still preserved on stones with tolerable frequency in Cork and Kerry. It is wholly in straight lines, arranged in rows on each side of a vertical stem line, and its use extended into Christian times on sepulchral memorials. In his "Philological Lectures" (London, 1877) Professor Rhŷs has the merit of being the first to decipher this Ogham writing by means of bilingual inscriptions in Wales. Ogham stones are found not only in Ireland, but also in Scotland and Wales, Devon, and Cornwall; and its alphabet is closely connected with that of the Germans before they adopted the Runic characters. The consonants are represented by groups of straight or oblique lines crossing or resting on the base line, usually the edge of the pillar, the vowels by cuts or notches. The so-called Celtic characters in which old Irish MSS. are written are in no wise Celtic. They are due to the early Christian monks, and are simply the Roman letters of the fifth century, with a few dots added over the letters where the sounds are aspirated, &c. In war, though metal arms were known, the old stone weapons long continued. These were simple missiles, thrown from the hand or from a sling, and fashioned stones in the form of spears, axes, maces. An iron handle with several iron balls hung to it by chains was long a favourite weapon. The shields were more often of wood than of iron, covered with hides and with iron rims and bosses; armour was uncommon, but the heroes are described often as wearing what might be described as leathern armour, with seven thicknesses of hides, as they drove to battle in their scythed chariots. In point of cumbersomeness this sevenfold leathern armour must have almost equalled the plate armour of centuries later, one would think. When the heroes fell they were burnt on a great funeral pile, or were solemnly buried unburnt, amid the long-continued wail and eulogy of the bards; and their remains were placed in great barrows or mounds, as at Drogheda, or under vast heaps of stones called cairns, or under huge boulders, the flattest of which formed a roof to the rest; this last is the tomb-like cromlech. As the dirge has survived in the "wake," so the annual games at the cromlech of a hero remain in the "fairs" with their rough sports.

The Conversion of Ireland.—Pope Celestine I. sent Palladius as bishop to Scotia or Ireland in 431 A.D., but the "Irish believing in Christ" to whom his brief sent him drove him away. He found a resting-place in Caledonia and died there. Patricius, St. Patrick, was a man of truer missionary temper. He landed near Bray in 432, whether sent by the pope, and even whether he arrived in Ireland before or after Palladius, are matters of controversy. He was a Gaul of Britanny, according to the usual tradition, and had been captured by King Niall (O'Neil) and taken to Ireland as a slave. He studied at Tours and at Auxerre under St. Germain. He built a little church on the shores of Strangford Lough, and succeeded eventually in getting a hearing before King Layary, son of Niall. Layary he could not convert, but two of the princesses became his disciples and protectors. The tradition says that 365 churches and monasteries were founded by him; one at least, Armagh (455), is tolerably certain. His burial-place (465) is commemorated in the name of Downpatrick. Ireland (Scotia) now became Christian with all the ardour inherent in the glowing Celtic nature. Great schools arose, one with 3000 monks, and Scotia was the home of the highest learning and the purest faith in Europe from 600 to 800 A.D. The Irish missionary St. Columba (Columbkille, "dove of the church") founded the far-famed Iona monastery in 563, "the morning star of Scotland's faith." Tara was now deserted on account of a murder, and the seat of royalty varied. At a meeting in Derry in 575 the independence of Dalriades (Irish Scotland) from Scotia (Ireland) was agreed to in the presence of Columbkille. Columbanus converted whole tracts of the continent of Europe about 600; his pupil St. Gall lives yet in the name of a canton of Switzerland. The court of Charles the Great later on was full of the learned Irishmen, whose fame was everywhere. One of the greatest of the schoolmen was specially called "John the Scot (or Irishman), born in Erin," Johannes Scotus Erigena (died 874). [See ERIGENA.] The illuminations of these early Irish monks are very fine and characteristic.

The Danes.—In 795 occurs the first recorded appearance of the Norse pirates off the Irish coasts. Thurkill conquered much of the mainland and made Armagh the Danish capital in 832. The Irish fought all five kingdoms one against the other, the Danes fought with the Irish and also with one another. The island reeked with blood. Yet the Danes steadily grew in power.

Ulath, Laighean, Muma, became Ulster, Leinster, Munster, from the Danish *stadr*, a place. Connaught preserved its pure Erse name (Olnegmacht). We get Wex-*ford*, Carling-*ford*, and other "fords," also showing us where the great Danish strength lay. The hateful nose-money supported

them as the equally hateful danegeld did in England: the tax deriving its name from the fact that those who did not pay had their noses cut off. The Danes united now with one king now with another as their interest served. Thus they helped the O'Neils to the sovereignty of Ulster, and Bishop Cormac MacCuileanan to the throne of Munster in 901. This is the Cormac who wrote the Psalter of Cashel. Amlaf was the Danish king of Dublin at this time, and was one of the five kings defeated by the English Athelstan at Brunanburh in Lincolnshire in 937.

A great figure of this Danish period is Brian Boru (or Boroimhe, "of the Tribute"), who from being only King of Thomond (South Munster) added Desmond (North Munster) to it, and soon attempted the overlordship of Ireland. Malsca (or Malachy), king of Ireland, was forced to become the mere King of Meath in 1002, and Munster, with Brian at its head, now became the leading state. The Danes were made tributary, palaces were built, roads and bridges constructed out of the enemy's contributions, a mode of payment dear to the Celtic heart. As Moore has sung, a maiden covered with jewels could pass from one end of the land to the other unrobbed and unharmed in the twelve golden years of brave Brian Boru. In 1014 Wales, Cornwall, the Orkneys, and Scandinavia joined the subject Irish kings against Brian, and he had to meet 21,000 men, an enormous force in those days. Though his years were eighty-eight he flinched not from the contest, and indeed raised an army not far inferior. At Clontarf, in Dublin Bay, he utterly routed his foes, but while he knelt to offer thanks for the victory vouchsafed a Danish noble stabbed him in the back. He was interred with splendid rites in Armagh Cathedral (1014), and his old rival Malsca resumed the throne till his death in 1022. The Danes now occupied the east coast, with Dublin for a centre, firmly established; their kinsmen at this time were ruling all England with a strong hand under Canute. Later we find Harold and Leofwine, sons of Earl Godwine, taking refuge in Munster, and giving their sister in marriage to the Irish king Donoghue. Hereward the Wake, the stout English champion who so long resisted William the Conqueror, he too had once to fly to Ireland. Thus the two countries began to draw together, Norman and English settlers appearing in Ireland here and there. This did not hinder a terrible civil war raging for thirty years between the Ulster Ui Neill (O'Neils) and the Munster O'Briain (O'Briens), descendants of Brian Boru, for the overlordship of Ireland. When they were thoroughly worn out the natural result followed; during the peace of exhaustion both were alike attacked by the King of Connaught, Toirdealvac mon o Concovair or Turlough O'Connor, styled the Great, who swiftly gained pre-eminence in Ireland, and in 1151 overthrew the last resistance in Munster. He died in 1156. After the short reign of an O'Neil, Ruaithri O'Concovair (Rurie or Rory O'Connor) came to the throne of his father in 1166. Having now reached the period of the Norman invasion, it will be well to note a few distinctive points of the native Irish civilization before it changed by contact with the intruders.

The Septs.—The unit of ancient Ireland was not the family, but the *Sept*, a body of families and their servants. all connected by blood relationship, and forming part of a *Clan* (literally descendants, *i.e.* of a common ancestor) comprising several septs. The freemen of the clan held land in common by the customs of *Tanistry* and *Gavelkind.* Tanistry remained in force till comparatively recent times, and its effects govern Ireland yet; gavelkind still exists here and there, not only in parts of Ireland, but locally in England also. The tanist or chief of the clan was not necessarily the last chief's son, though it often happened in practice that he was so; in theory the tribe elected its best man. He was nominal owner of the land for the tribe. Part of it was held in perpetual tenancy by the free tenants, and the chief of course among them; at a man's death the custom of gavelkind divided all his land among his sons equally. Another part of the land belonged to the chief as tanist, and its income was devoted to his support in his office. Finally, the remainder was annually shared among the whole of the freemen of the tribe. Those who became yearly tenants acquired certain rights, and in time could become free tenants; and the labourers, slaves bound to the soil in a sort of serfage, had their rights too, and could claim sustenance and shelter. All this is clear in the Brehon laws, preserved in the ancient Seanghus Mor (Great Law); and it thus becomes manifest that Roman law, elsewhere the basis of society, had in Ireland never gained a footing. Until Henry II. invaded Ireland these laws of tanistry and gavelkind were universal. Any man can see at once that the legitimate outcome of this, as time went on, would have been an industrious and thriving race of peasant proprietors. Instead of this, by centuries of attempts to thrust upon the Irish Roman legislation, and views of ownership which are alien to them, and which they have never as a race been able to understand, the melancholy result of a nation of wretched cotters paying everything they earned beyond the scantiest subsistence to the agents of alien landlords was until recently seen. Tanistry was practically in force until the conquest of Cromwell. The Irish Land Act of 1881, as described in the paragraph on *Agriculture* in the present article, was an attempt to reconcile the two diverse forms of landholding.

Those septs in wilder districts who were more than usually harassed lived in crannogs or island-dwellings, built on piles in shallow lakes, bearing log-houses thatched with straw for the chiefs and round wattled huts for the common folk. The chest served as cupboard, seat, table and couch for each man. Leather bottles held ale and mead. The men's weapons hung on the wall, the women's spinning-wheel and hand-mill or quern stood in the corner. Oatmeal was the staple food, besides meat; and nutmeal, made from ground acorns and filberts, was also used. Milk, butter, and cheese were plentiful, and indeed the cow was the standard unit of riches. This primitive life would hardly have led one to expect the artistic and beautiful work in stone and metal and in illuminating that the early Irish produced. Nearly all the fine gold work of the earliest times in the United Kingdom, as possessed by our museums, is Irish. The *torcs*, collars or anklets, of gold, diadems, and brooches are of real beauty. Enamelling is found in some cases. The illuminating is elsewhere spoken of, and the colours of the "Book of Kells" (in Trinity College, Dublin), which some attribute to St. Columba and to the early date of 600, though this is disputed, are as bright to-day as when they were laid. The Irish harp (*cruit*), the violin (*fidil*), the drums (*tiompan*, compare the Italian *timpano*), the pipes (*piopai*, bagpipes), the horn (*corn*). and the small trumpet (*stoc*, the "tuck" of Shakspeare probably), formed the musical instruments of the Irish. This is a remarkable variety, showing a high state of musical attainment, fully up to the level of that attained in the decorative arts. They were good at church bells also; and used the *crotal*, a closed form of bell with a loose ball within it, as a jingle to accompany other music.

The Angevin Conquest of Ireland.—Diarmuid, king of Leinster, abducted Derrevorgail, wife of O'Ruairc, a Connaught chief, and the latter appealed to the overking, Turlough O'Connor (1153). Diarmuid, forced to make restitution, plotted unsuccessfully for revenge, until he had to fly the country in 1169 to seek the aid of the English king, Henry II. of Anjou, who had obtained at his accession in 1154 from Pope Adrian IV. (the only Englishman who ever became pope) the titular sovereignty of Ireland. The popes claimed in some extraordinary way to have the right of feudal suzerainty over all islands. Henry promised to enlarge the bounds of the church, &c. One is tempted

to say that it was rather to enlarge the bounds of his kingdom that he was anxious; but in justice to him it must be said that Ireland had sunk back almost to heathendom, and that the constant Irish practice of kidnapping Englishmen and selling them into slavery in Ireland constituted a real danger. Nevertheless the opposition of the English baronage, eager for peace in their own land after the lawlessness of Stephen's time, was so great that Henry had to reluctantly forego his Irish schemes. Fourteen years after came Diarmuid seeking him when he was in his foreign realm of Aquitaine, and Henry at once granted him letters patent. Under these Fitz-Gilbert, called Strongbow, who soon after succeeded to the earldom of Pembroke, and some other adventurous Norman knights agreed to help the exile. A band sailed across in 1169, but King Ruaithri privately agreed with the traitor to admit him again to the sovereignty of Leinster on condition that no more Norman knights were invited from England. But Diarmuid now aimed higher, and Strongbow also finding the advance guard successful was eager for conquest. He landed near Waterford in 1170, married Diarmuid's daughter Aeive or Eva, and was promised the crown of Leinster at the death of his father-in-law. This of course was in flagrant violation of tanistry. Aeive had no more right to the crown nor to the lands of Diarmuid, than any other person. It is probable that Strongbow would not understand the tribal system; at any rate he overthrew it. Strongbow proclaimed himself King of Leinster therefore, and fought his way to actual possession of the crown, on Diarmuid's death in 1171. Henry II., justly alarmed, ordered all loyal Englishmen to return to England. Strongbow first defeated a great attack of combined Irish and Danes upon his capital, Dublin, and then hastened with the astuteness of a statesman to lay all his conquests at his master's feet. Henry sailed at once from Milford, received the submission of the greater part of Ireland, which he mistook as a feudal homage, divided it into ten governments under Anglo-Norman knights, but really gave Ruaithri, the Irish king, jurisdiction over the whole land except the English pale. This select territory, whose capital was Dublin, created by Henry an appanage of the city of Bristol (then the leading English port), comprised Dublin, Meath, Wexford, Waterford, and Dungarvan. All over Ireland a royal tax of an hide for every ten oxen killed was levied, a practical proof of the suzerainty of England. But what to Henry was an acknowledgment of feudal right of overlordship was to the Irish mere temporary submission to the strong hand. The Norman knights quarrelled with one another, so that in 1185 Henry sent them an overlord in the person of Prince John, then nineteen, whom he created Lord of Ireland. Ranulf de Glanvile and Giraldus Cambrensis, the famous historical authorities, accompanied him. John let his officials do the work, and amused his savage nature by such rough horse-play as pulling the wild beards and mocking the dress and gestures of the rude chiefs who came to do homage. He succeeded in this way in thoroughly alienating those Irish who were endeavouring to learn the ways of their strange English conquerors, and understand the strange views they held of their rights over the land, and in similar ways he roused an equal hatred among the Norman settlers. John cared not whether he despoiled his English nobles or his Irish subjects; it is therefore no wonder that the English pale grew under his reign. As he left it, it consisted of Dublin, Kildare, Meath, Louth (then called Oirgialla), Caherlow, Kilkenny, Wexford, Waterford, Cork, Kerry, Limerick, and Tipperary. His castle at Limerick shows the great strength of the Norman border fortress in perfection, and this was but one of a dozen along that march. When Henry III. succeeded John, he continued John's viceroy Morisco in office, and in 1217 we find a specimen of the way in which the Irish were treated. Remembering the glories of Iona and the Irish Christianity of 600 to 800 A.D., it is certainly with no pleasant feelings that we read Henry's stern order to prohibit any Irishman from being admitted to preferment in any church in the English pale. In vain the popes protested, annulled the decree (1224), &c., the council supported the king in his tyranny. Even when Irish Parliaments began they also shared in wronging the Irish. Thus the statute of Kilkenny in the Parliament of 1367, and Acts of Parliament in 1416 and later, expressly approve and renew Henry III.'s prohibition. Yet advantage was taken of Irish customs when they suited the invaders. Thus the Irish had a "blood-fine" like the worgild of the Old English. Norman adventurers who killed an Irishman therefore counted it no murder, and were held acquitted by a small payment into court. In so many ways did they by force or cunning crush the Irish that those dwelling along the borders of the pale offered Edward I. (son of Henry III.) 8000 marks to admit them under the English law. That good and great king was ready to do this, but his English subjects saw their danger and protested so strongly that though he granted the prayer of the Irish he had to abandon the project of enforcing the rights he had granted.

The Fitzgeralds, or Geraldines as they were called, rose at this time to commanding power, and their feuds with the rival family of the De Burghs caused never-ending bloodshed. The latter were paramount in Ulster and the English fringe of Connaught, and in 1315 had to make a stand against a fresh enemy. This was Edward Bruce, brother of the Scottish king, who was invited to help the native Irish in a revolution against the Saxon. Bruce and O'Neil seized Dundalk and advanced to Coleraine, where he gained so decided a victory over De Burgh that he was crowned King of Ireland. Leaving a part of his army besieging Carrickfergus he advanced on Meath, and defeated Butler the viceroy at Kells. Robert Bruce now landed in Ireland with 20,000 Scots and speedily reduced Carrickfergus, joined his brother, and marched with him on Dublin. Here they were met with so firm a front that they had to retreat, and that amid such extremities of famine that they had to devour their horses. Robert Bruce saw nothing great was to be accomplished and retired in 1317. His brother fell next year near Dundalk; his head, preserved in salt, was sent to King Edward II., and the victor, De Bermingham, was made Earl of Louth. The wretched country after the discomfiture of the Scots might hope for peace, especially as in spite of stringent prohibitory laws the English were intermarrying with the native Irish, adopting their dress and customs to some extent, and by long dwelling in the land had come to feel some kinship with them, at the expense, it must be admitted, of somewhat of their own civilization. One could welcome even this temporary roughness for the sake of permanent union. But this was not at all the view of the English court.

A sharp ordinance of Edward III. (1342), alarmed at the growing Hibernicism of the English of the pale, declared that all lords in Ireland who did not also hold land in England must be banished and give room to Englishmen holding land in England. Thus once more did England deliberately ruin Ireland's promising future. The new English who came into Ireland under this law were detested by the old English, such as the Geraldines (Fitzgeralds), &c. These had become, as the proverb ran, *Hibernicis hibernior* (more Irish than the native Irishmen). The chief of the old English were the earls of Ormond (Butler), of Desmond (Geraldine), and of Kildare (also a Geraldine). Their mutual animosity, as usual in this unhappy land, was none the less fierce for the manifest reason they had for uniting against their common foe. At last a stronger viceroy than usual, Sir Ralph Ufford, 1344, imprisoned both Ormond and Desmond, and obtained for a brief time some modicum of peace. Evidently the country must be taken firmly in hand if it were to be made into a law-abiding nation. With

this view Edward III. sent over in 1361 his son Lionel, duke of Clarence (from whom the House of York was to descend), as viceroy for three years, and he returned twice subsequently. He was very stern, but he was just; and though the Irish feared him, they looked back on his administration as that of one who meant them well. Their faithfulness to the descendants of Lionel is phenomenal. Yet it was Lionel who called the Parliament of Kilkenny (1367), which has been previously referred to. Alliance with the native Irish, or adoption of Irish ways or customs, was sternly forbidden by this Parliament, as far as English (either new or old) were concerned: default was to be considered high treason! Private war was forbidden. The Irish clergy, the Irish cattle, and the Irish bards are classed together contemptuously as things not to be favoured or encouraged. The petty taxation, on which the native Irish chieftains subsisted, the *coigne*, paid less in money than in fodder and stabling, it was made felony to demand. In one word, the native Irish were to be isolated. But there was no power to enforce these provisions, which therefore only served to exasperate the Irish and the Anglo-Irish. It was always Ireland's misfortune that she was just strong enough and uncivilized enough to hold the English at bay, and to refuse to amalgamate with them. With a near successor of Lionel, William de Windsor, the title of Lord Lieutenant of Ireland first began in 1369. At this time the English government revenue from Ireland was £10,000, and the expenditure £11,000. On Clarence's return Edward therefore summoned the Irish clergy and laity to attend for taxation at Westminster by their deputies, to which they unwillingly consented. Thus did Irish legislators first appear in England.

It was not long before the short-sighted policy of Edward III. showed its ill effect. The new English, that is, those lords of lands in England, in favour of whom the old English or English holders of purely Irish land had been dispossessed, had shown, as was but natural, a tendency to reside on their comfortable and safe English estates and farm out their Irish lands for what money they could get. The cultivation sank, and with it the revenue. Richard II. tried to cure this absenteeism, not from love of Ireland but care for the revenue; and as he failed he sought to gain his end in another way, namely, by fining all absentee landlords of Irish lands *two-thirds* of their annual revenue unless they were absent by royal license, in which case they were mulcted in one-third only. The daughter of Lionel of Clarence and Elizabeth de Burgh (heiress of Ulster) married Edmund Mortimer, earl of March. He then became Earl of Ulster, and was lord lieutenant from 1380 till 1385. King Richard II. himself came over in 1394 with a considerable army, and brought order so far into the land that seventy-five chiefs submitted, and the four Irish kings came to Dublin to swear allegiance and receive knighthood. When he left, in about a year, Roger Mortimer, earl of March (son of Edmund), remained as lord lieutenant. Mortimer perished in a border conflict with the wild Irish, who had revolted, led by Art MacMurcha, a typical chief of the time, who could pierce a steel cuirass with his long javelin riding headlong on his barebacked horse. Richard landed at Waterford in 1399, determined finally to stamp out this revolt, which had become formidable. It seems the irony of fate that his one earnest attempt towards good government cost him his throne. In the endeavour to follow the wild Irish among their bog and mountain fastnesses the army became entangled, and meanwhile Richard learnt that his cousin, Henry of Bolingbroke, whom he had banished and outlawed, had challenged the English crown. Before he could get back to England Henry was practically its king. Ireland was almost lost. King John's twelve counties of the pale now shrank to four only, Dublin, Meath, Kildare, and Louth. The king's revenue under Henry IV., the new monarch, did not suffice for payment of the royal officials; and many of the Irish barons claimed to hold princely state and to be altogether independent of the king.

The anarchy in Ireland at the beginning of Henry IV.'s reign, the bloodshed, the pillage, the fire, were most terrible. The Irish as usual fought with each other and with the English; the English, whom they drove to bay, yet managed, as well as fighting the Irish, to fight with each other also; the Scots, to give another touch of misery, made an inroad on the coasts of Ulster, and the men of Dublin characteristically found time, without disturbing their Irish quarrels, to make reprisals on Scotland. The O'Byrnes at this time were menacing Dublin; a great victory over them was commemorated by the grant of a gilt sword to be borne ever afterwards before the Mayor of Dublin, since it was the then mayor who led the royalists. Thomas, duke of Lancaster, brother of Henry V., young as he was, tried to bring Ireland into order under Henry IV. and Henry V.; but the great Talbot, afterwards Earl of Shrewsbury, was the first to succeed in moderating the utter lawlessness which prevailed. His lord-lieutenancy began in 1414. His plan was to conquer one sept or tribe, say the O'Moores of Leix, then to force them to march under his flag against their native enemies, the MacMahons of Ulster, and so on. In this way in three months he had brought back some semblance of order, and his strong hand maintained it as long as he remained in Ireland. Ormond, as lord lieutenant, followed somewhat later the same policy. Yet amidst these fluctuations the balance was against England. In 1430, under the minority of Henry VI., it was stated in Parliament that the English pale was practically reduced to Dublin. In 1449 the Duke of York, heir by strict law to the crown of England, heir also of the earldom of Ulster by the death of Edmund, earl of March, was sent to Ireland as lord lieutenant, with the additional advantage of ridding England of his presence. The memories of Mortimer and Clarence were turned to account. Richard of York was virtual king of Ireland, not only conciliating the English nobles, but winning the native Irish with tact and courtesy. When his son George of Clarence was born at Dublin, the lord lieutenant invited Desmond and Ormond to be sponsors at his baptism, thus uniting them in *gossipred*, a relationship perhaps more binding than the ties of blood. Unhappily Cade's rising in his favour called the duke to England in 1450, and Ireland lost a good friend. Many Irish followed his standard in the Wars of the Roses, and over 3000 of the best of them fell with Richard of the White Rose at Wakefield.

On the accession of the house of York, Edward IV. appointed his Dublin-born brother Clarence lord lieutenant of Ireland; and later on Richard of Gloucester, another brother (Richard III.), was also viceroy. But the Wars of the Roses were as fiercely fought in Ireland as in England, the Desmonds being Yorkist, the Ormonds Lancastrian. Consequently when Richard III., the last York king, perished at Bosworth, and the Tudors brought the Lancastrians again into power, Ireland was the great scene of Yorkist plots. It was in Dublin that Lambert Simnel was crowned king with great ceremony, pretending to be Edward of Warwick, son of the dead Clarence, Whitsunday, 1487. The pretension was the more absurd as the real Edward was a prisoner in the Tower at the time. Henry VII., in summoning some Irish lords to Greenwich later on for their homage, quietly let them be served as a footman by this Simnel, whom they had crowned, and whom, after his defeat, he had wisely refused to behead, and so to perpetuate the imposture. The second impostor, Perkin Warbeck, son of a boatman of Tournay in Flanders, who claimed to be Richard of York, the boyish son of Edward IV., slain in the Tower under Richard III., also met with warm support in Ireland on his landing in 1491. Three times did Warbeck return to Ireland after his failures; but his

fourth landing found the Geraldines his foes, and he fled to Cornwall. When he was hanged at Tyburn in 1499, his earliest Irish adherent, John Water, swung beside him on the gallows. Eventually the famous Sir Edward Poynings was sent to quell this home of sedition in 1494. Summoning a Parliament at Drogheda, Poynings got the famous measure known as Poynings' Act passed, by which all statutes previously made in England were rendered equally valid in Ireland; and no Parliament could be called in Ireland without the king's license, nor any bill be introduced without the previous approval of its provisions by the English council. Other Acts preventing the possession of cannon or guns without license, ordering the erection of an actual stockade or pale round the four loyal counties, &c., were also agreed to. Poynings was replaced in 1496 by the Earl of Kildare, who had won the royal favour by his conduct when arraigned for treason. "All Ireland cannot rule this man," said his enemies. "Then shall he rule all Ireland," retorted the king. He was a vigorous soldier, and when once he had definitely espoused the side of order, he was not content with half measures. The Burkes were now the leaders in Connaught. descendants of the ancient De Burghs; the O'Briens and O'Connors rallied to them as Kildare approached, with O'Donaill and many Ulster lords in his train. At Knockdoe, Galway, on 19th August, 1504, the west was thoroughly vanquished for the first time by the English party; 9000 Connaught men bit the dust. Kildare followed up the victory, and under him and his son after him the country began to breathe.

With the accession of the handsome and beloved young Henry VIII., men believed that everything everywhere was to start on a fresh footing. Truly the activity of the reign in social and political changes was prodigious, probably superior to any other. Ireland also felt its effects. A report was ordered by the king. This ascertained that the land was held by thirty lords of English and sixty of Irish descent, and that only the pale was entirely subject to English law. The pale consisted at this time of the maritime counties from Louth to Wexford, and but little else. Beyond its borders the Irish levied "blackmail." The Geraldines were the real monarchs of Ireland; the royal authority was almost *nil*. Among the viceroys whom Henry appointed to tame Ireland, as he had tamed England, was Surrey, one of our earliest poets; and it was here that he met that Lady Geraldine upon whom he has conferred a poetical immortality. She was one of the Kildare, not the Desmond, branch of Fitzgeralds. Under Surrey and men of similar stamp, and by repeated summonings of the Geraldines to London on charges of insubordination, treason. &c., and finally, by the capture, after an unsuccessful outbreak, of six of the leading Geraldines at once (which caused also the old Earl of Kildare to die of grief in his prison in the Tower of London), and their beheading on Tower Hill in 1537, the royal authority, through the mingled powers of statesmanship, of the fascination of genius and culture, and of mere brute force, began rapidly to extend. Henry battered down with his artillery the castles of those who resisted, while he promised (and really gave) friendship and protection to those who would have them. He could suppress the Irish as well as the English monasteries in 1536, and he could get an Irish as well as an English Parliament to throw off the papal allegiance and acknowledge the king as head of the church. (But this he only accomplished after dismissing the clergy from the Parliament.) The time was indeed now ripe for the submission of Ireland, and the nobles, not by misunderstanding, as in their submission to Henry II. ages before, but with a full knowledge of their act, acknowledged Henry's new title of King of Ireland, which he substituted for Lord of Ireland (*Dominus*), borne by all the kings of England since John. The change was emphasized by the first National Irish Parliament, that of 1541, when the Irish as well as the English lords were summoned, and Burke (or De Burgh) was made Earl of Clanricarde, O'Brien Earl of Thomond, and O'Neil Earl of Tyrone.

This wise policy of Henry was most unhappily not followed. It is really extraordinary how every chance the country has had up to our own times has seemed to wither in the very blossoming. Henry VIII. was over and over again pressed by the "pale" to crush native Ireland. He refused. Disorder he did crush; but as to wider aims he abandoned force for the longer but more thorough method of winning over the chiefs one by one to become English nobles, knowing well that with their blind Irish devotion their whole tribes would follow. The native chiefs found for the first time a king who desired to be their king rather than their conqueror. Chief after chief accepted Henry's parchments, promised the moderate tribute claimed, foreswore private war and private taxation, took the English title which was offered, and sent one son to England to be educated. In a few cases only was English dress insisted on, and even Irish law was allowed as a temporary indulgence over a large part of the island. In most cases a handsome gift was presented to the new "lord" —but the absolute ownership of the land which Henry recognized, either not comprehending or not caring to recognize the Brehon system of tanistry, was a gift of greater importance. When the tribal conditions were sought to be maintained the law courts steadily refused to acknowledge any other than the strictly feudal tenure.

At this time the rigid exclusion of Irish clergy from the churches of the pale, and its natural consequence, the exclusion of English religious influences from the native Irish, had suffered the latter to fall into almost a heathen condition. So far as they were religious at all and listened to the few friars who went among them they received the Roman Catholic faith. But when these venerated friars and the widely scattered native priests were thrown into prison, and when the staff of St. Patrick was publicly burnt, while they were forced to listen to the preaching of foreign ecclesiastics who knew not a word of their tongue, the question of the royal supremacy began to take another aspect to the Irish. Men's minds were stirred, and by the close of Henry's reign Ireland had achieved unity on one point at least—it had become thoroughly Catholic. The rapid Protestant changes under Edward VI. went far to undo the tender commencements of political union due to Henry; and though the restoration of Roman Catholicism by Edward's sister and successor Mary met the religious desires of the Irish, the queen ruined the position she might have taken by her unfortunate inauguration of the system of planting colonies.

The Colonization of Ireland.—Mary began by granting to English settlers vast domains of land if they could hold them against the Irish. In these days men were adventurous, and a few months saw the Irish driven out or exterminated from the districts named, and the addition of two English counties to the pale; the first being called Queen's County, from compliment to Mary, the second King's County, from compliment to her husband, Philip II. of Spain. The sudden backward swing of the pendulum when Protestant Elizabeth, with her stringent Acts of Uniformity and Supremacy, began her great reign, finished the goading of the Irish to madness. They rose under a native hero, Shane O'Neil (John O'Neil), an illegitimate son of the Earl of Tyrone, whom the clan had elected as chief after the murder of the earl's heir. Shane rapidly became master of the north (1561). Elizabeth, now queen of England, endeavoured to return to her father's policy. Shane was invited to London, where his train of armed *galloglasses* with their flowing hair, saffron-dyed coarse tunics, and cloaks of the fur of wild beasts, made a nine days' wonder. In return for his submission he received

the queen's pardon. Once back in Ireland, however, he could not remain tranquil. He made a raid on Connaught, which rose at his bidding, and on the Dublin council sending him orders to lay down his arms he replied, "By my sword I have won these lands, and by my sword I shall keep them." Elizabeth reluctantly ordered Sir Henry Sidney to use force. Shane was quickly overpowered and fled to the Scottish colony in Antrim, where he perished in an obscure drunken brawl (1567). Elizabeth at once ceased the open use of force, and one sign of her policy is that with all her hesitating dislike to Parliaments she called three in Ireland, 1560, 1567, and 1585, a greater number than ever assembled before in the same time. Though in England she was sternly enforcing the supremacy, she suffered it to remain a dead letter in Ireland. English priests were appointed, and the Protestant Episcopal church in Ireland was established, but the Irish went to mass unquestioned. There was literally no persecution, and the Irish had many years of peace and good order. Therefore the Roman Catholic powers, with Spain at their head, who hoped to use Roman Catholic Ireland (as they afterwards tried to use the Queen of Scots) as a lever to dethrone the great queen, found themselves baffled. Stukely, an Irish refugee, led a small Spanish force to Kerry, with a papal legate and the blessing of Rome itself, in 1579, and they were joined in the small fort they had seized by a rather large force in 1580. Desmond now joined them, but Lord Grey of Wilton, then lord lieutenant, captured the whole body save Desmond, who was hunted for three years as an outlaw. He fell into the hands of the English at last, and his head was stuck on the spikes of London Bridge (1583). His estates, 500,000 acres, were confiscated and shared among "undertakers" (English colonists). The whole of the south was remorselessly harried; the hatred of the Spaniards and Catholics drove Englishmen clean away from the wise Irish policy of years. It was during this time of fury that the Irish equivalent of Glencoe occurred in Leix and Offaly (King's and Queen's Counties), when Sir Francis Cosby, in 1579, invited the leading chiefs to a banquet at Mullaghmast, and murdered them to the number of 400. Mullaghmast is not the only such treacherous act, nor was this class of warfare confined to either side. Sir Nicholas Maltby crushed out with pitiless severity a rising of the Bourkes. So bitterly did the Irish suffer, that when the Armada was in the straits off the coast, not a chief moved a hand to help, and many aided in plundering and massacring the countrymen of those by whose side they had fought a few years before. Among the "undertakers" were Edmund Spenser and Sir Walter Raleigh. The first received the Castle of Kilcolman near Doneraile, in "the barren soil where cold and want and poverty do grow;" and his sympathy took the practical form of a plan, issued after the Tyrone rebellion mentioned later on, for rooting out marauders and enforcing order by castles built at given intervals all over the land. His plan is somewhat stern, but it was manifest that restoration of order was the first thing needful. Spenser's "View of the State of Ireland" is a priceless document. Raleigh, whose activity showed itself in action rather than thought, used to reproach his friend with sitting always idle, among the cool shades of the green alders by the Mulla's shore, not knowing that in that apparent idleness was shaping itself the "Faerie Queene," in its own way the greatest imaginative poem we have. Raleigh's actual work was fully as stern as Spenser's "plan."

What caused the severity of captain and poet-philosopher was the terrible insurrection of Hugh O'Neil, the nephew of Shane. He had been retained and educated in England, and was made Earl of Tyrone in 1587. But the training he had received and the support which the queen's government gave him, hoping through him to gain Ireland, he turned against those from whom he had them. As soon as he had all the strings of government in the north in his hands he threw off the mask and defied the queen (1598). He demanded the expulsion from Ulster of every English soldier or official, and the restoration of the church lands of the Roman Catholics. The queen, though now old and near her end, rallied to the danger, steadily spent £12,000 a month on an Irish military expedition, and sent her favourite courtier Essex to command it (1598). The sudden return of Essex to London without leave (1599), his pardon, his subsequent treason, and his death, concern us here only so far as that his abandonment of his post threw the expedition into confusion and enabled the insurgents to sweep with fury over the country. We know from Spenser how he fled for his life from his blazing castle. Mountjoy, the successor of Essex, found himself master only of Dublin and 3 miles round on his arrival. The Spaniards sent 4000 veteran soldiers to Kinsale. Mountjoy attacked these first and succeeded in obtaining their surrender. Unable to keep them himself he allowed them to return to Spain (1602). The same success steadily attended Mountjoy's arms, as he won back the country mile by mile, throwing up forts as he went. On 30th March, 1603, Tyrone sued for pardon at Mellifont in Meath, six days after Elizabeth had died; the other leaders fled to Spain or surrendered. Mountjoy had used much severity, and a terrible famine came to complete the overthrow of the Irish of the north.

Plantation of Ulster.—Sir Arthur Chichester, who followed as lord lieutenant soon after the victorious Mountjoy, thought the time was now come to Anglicize the country, now so submissive. English law and customs were accordingly pressed upon the people, who offered them the steady dumb resistance of the injured. Yet the good faith of the viceroy and the inherent superiority of the changes he proposed were working wonders, individuals and towns were receiving English charters, and no reasonable doubt can be felt that in one reign, served by such lords lieutenant, we might have seen the growth of a loyal and prosperous Ireland. Again, however, the cup was to be dashed to the ground. The new king, James I., rightly or wrongly, suspected the late rebel Tyrone (Hugh O'Neil) and his brother rebel O'Donaill, the Earl of Tirconnail. The earls got wind of a probable arrest, and fled to Rome, where they died, the first in 1616, the second almost on his arrival. James confiscated the whole of their estates and much more besides, nearly 4,000,000 acres in all; and roughly turning away the native Irish from the fertile parts of this large area he determined on really carrying out the policy which Mary had only shadowed forth. The citizens of London undertook, as the Irish Society, to colonize Derry. The rest of the land, about 750,000 acres, was cut up into homesteads and granted in lots of 1000 or 2000 acres to such colonists as would engage to build a strong house with an inclosed courtyard, and to plant at least forty-eight English or Scotch colonists on the estate within three years, and to reside there themselves for five years. The new owners were Scotch or Irish Protestants; a few Anglo-Irish and a very few native Irish (not one-tenth) were also admitted. Two-thirds of the north of Ireland was thus depopulated and repopulated. The effect was magical. Farms and mills and homesteads, Protestant churches and schools, good roads and bridges, clean pasture and tillage appeared where desolation and rapine had long reigned. But at what a terrible price! Never since have rulers until Victoria gained credit for good faith from the Irish; the prosperity of Ulster has been a hateful reminder to them, its Protestantism a standing grievance. But in our happier later days Ulster, which preserved the remnants of the old tanistry in its custom of tenant-right, has in this way been the means of vast benefit to the country, and has wiped out the old debt by giving the basis to the Land Acts of 1870 and 1881, already described in the section on *Agriculture*.

In 1612 an Irish Parliament of fifty lords and 232

commoners was called to approve the work of James. So far from being willing to do this, it showed its temper in the election of a speaker. The royalist minority, however, took Sir John Davis, whom they had nominated, and thrust him by force into the chair, actually into the lap of Sir John Everard, the gentleman chosen by the majority. It needed much "management" to avoid a rupture and to gain the king's ends. Forty new small boroughs were created for one thing, an evil which remained till our own day. In 1615, 80,000 more acres were divided among English settlers in Leitrim, Longford, Westmeath, King's and Queen's counties. Pleased at his success James was busy with a plan for planting Connaught when death surprised him in 1625. His plan was one eminently characteristic of him. Elizabeth had received the surrender of the Connaught lands and had regranted them, but the patents had not been enrolled, and upon this subtlety, worthy of a pettifogging lawyer, James would have declared the whole of the estates forfeited and planted a new Ulster. The Irish breathed again when he was gone. Their first impulse on the accession of Charles I. was to offer him £120,000 on condition of certain "graces," such as security of titles to land, removal of restrictions on commerce, and an oath of allegiance instead of the oath of supremacy, &c. Charles characteristically accepted the offer, granted the "graces" to the number of fifty-one, promised that an Irish Parliament should assemble to ratify them, and—never did anything more about them! It was in 1632 that Sir Thomas Wentworth (soon to be Earl Strafford), having abandoned the Puritan party for the king's council, determined to find in Ireland the revenue, the arsenals, and the forces for the contest which he foresaw was imminent. In only five years after he became lord lieutenant he was able to write to his bosom friend Archbishop Laud that "the king is as absolute here as any prince can be." He had begun by fair promises of confirming the "graces" and what not, and in the Parliament of 1634 he in this way actually obtained £300,000 in six subsidies. Perhaps it is needless to add the "graces" never were confirmed, and four-fifths of Connaught were declared by packed juries to have reverted to the crown for want of registered titles. Strafford's policy was "thorough," as he used to say—in fact a mere rule of terror. But instead of using his unparalleled strength towards uniting Ireland, the undoubted benefits he gave the land by his enforcement of justice, suppression of piracy and other lawlessness, &c., were only used for the ulterior object of the coming English war. He steadily encouraged the Catholics, to the rage of the Puritans of Ulster, and drove the first frantic by his promises to the latter of a colonization of Connaught; thus each part of the nation was distrustful of the other, and union against the king was impossible.

But Strafford's aim included the material well-being of the country. It was he who founded the splendid linen trade of Ulster. Desiring to found some great staple industry he discovered by inquiry that the soil grew flax well; he at once imported £1000 worth of seed and some scores of workmen from Holland, and set up six or seven looms. The revenue was doubled during his administration. His standing army of 5000 foot and 500 horse was admirably appointed. While Charles trembled before his Parliaments in England, Strafford could call the Irish Parliament together without danger and bid them "not to let the king find them muttering, or to speak it more truly mutinying, in corners." He received his title of Strafford and the dignity of lord lieutenant (the first since Elizabeth's time) in 1640. His resource is shown in his instant increase of his army to 8000 foot and 1000 horse on the first rumour of a probable Scotch advance in 1640. But he was hurriedly summoned by his master to take command of the English army against Scotland, and left Ireland to meet his fate at the hands of the Long Parliament.

The Massacre of 1641.—Strafford's iron hand once withdrawn the rebound from the tyranny he had exercised was terrible. The Long Parliament had insisted on the army in Ireland being disbanded. Owen Roe O'Neil came from Flanders, Rurie O'Moore roused all Leinster. A vast conspiracy crept swiftly over the whole country. On 23rd October, 1641, the rebellion burst out by general concert. Dublin was saved by a traitor disclosing the plans of his friends the day before. The conspiracy was so perfect that 50,000 English had perished before any resistance could be organized. Fearful and unmanly outrages, a very madness of ferocity, such as the great French Revolution and the Indian mutiny yielded later on, stained the honour of Ireland. Girls were stripped and violated before their fathers' faces, and then driven out naked to perish in the woods. Some men were burned, others drowned for sport, and if they swam were kept from landing with poles; many were buried quick (alive), and some set into the earth breast high and then left to famish (May). It was essentially a war of Irish Catholic against English Protestant, with all the cruelty that religious wars have ever produced. One of the O'Neils captured Dungannon and found a patent with the great seal attached. Writing a forged commission as from King Charles, he appended the genuine seal to it, and the insurgents then styled themselves the king's or more often the queen's soldiers (Charles's queen was a Catholic). Charles openly rejoiced in the political effect of the massacre, which would enable him to force the raising of an army nominally against Ireland, really against the Parliament. After this cruel conduct it can hardly be wondered at that the English Puritans disbelieved the king's repudiation of the forged commission. To them the Irish massacre was part of a great royal plot, and they refused to interfere. Ormond stood for the king in Southern Ireland, and a small force of Scots under Monro came over to assist their compatriots in Ulster. The Catholics assembled at Kilkenny, October, 1642, and demanded the abandonment of the Protestant religion and other changes. The pope sent a legate to this provisional government. Charles was base enough first to treat with this government at Kilkenny, and then, when he was discovered, to disavow his agents. In 1646 Monro suffered a severe defeat at the hands of the Irish. Ormond, seeing that the cause was lost, gave up Dublin to the Parliament of England and found his way to Charles. Armed with full powers to treat with the Catholics Ormond returned in September, 1648, and peace was proclaimed in Ireland in January, 1649. But before the news could reach London Charles had perished on the scaffold.

Cromwell's Conquest.—On the death of Charles I., Charles II. was proclaimed king in Ireland in several places, and his cousin Prince Rupert landed at Kinsale. Ormond, with the Catholics now all at his back, could answer to Charles for three-fourths of Ireland. Dublin and Derry alone belonged to the Parliament of England. On 28th March, 1649, Oliver Cromwell was named lord lieutenant of Ireland, and landed in August with an army of 8000 foot and 4000 horse, besides artillery, and a military chest of £20,000, a large sum in those days. Jones, who held Dublin, was second, and Ireton third in command. Cromwell at once issued orders directing all acts of private vengeance to be forbidden, and ordering that all provisions, &c., should be fully paid for. His proclamation speaks nobly. "We are come to ask an account of the innocent blood that hath been shed, and to endeavour to bring to an account all who by appearing in arms shall justify the same." Ormond, face to face with the finest soldier of the age, retired, throwing his best men into the fortress of Drogheda. Cromwell attacked the town furiously, leading the final charge himself. Determined to strike terror at the outset he ordered the soldiers to be slaughtered to a man, but private persons to be let go free. Nevertheless,

he himself records, "I believe all the friars were knocked on the head promiscuously but two." In a hotly disputed assault orders can scarcely be observed with discrimination. In the main Cromwell's statement stands without dispute. "Since my coming into Ireland not a man not in arms has been massacred, destroyed, or burnt." In nine months he reduced Ireland to subjection. Wexford had almost as terrible a fate as Drogheda, but, as Cromwell had anticipated, no further such extreme measures were necessary. After marching from victory to victory Cromwell could leave the island 29th May, 1650, for stern work in England, his son-in-law Ireton remaining as lord deputy. Ireton died of the plague in Limerick, which he had reduced after a long siege. Fleetwood, who married Ireton's widow, was lord deputy later on, and finished the Cromwellian conquest by bringing the prisoners to trial for the massacre of 1641. About 200 were executed, and shiploads were sent to slavery in Jamaica. Henry Cromwell, the son of the Protector, effected the settlement of Ireland on the fatal model of Ulster. The Irish Catholic gentry, all who had borne arms against the Parliament, were transported with their servants and cattle beyond the Shannon, which was to serve as the boundary of the new pale. Cromwell's soldiers received the confiscated lands, many native Irish remaining as farm-hands. Others, refusing to abide by these hard terms, carried their swords abroad into foreign service, to the number of 40,000. The same results followed—the material prosperity, the lasting hatred—as had followed from the Ulster settlement. Irish children are (or rather were) threatened with the curse of Cromwell. Autonomy was abolished, thirty Irish members were sent to the joint Parliament of the three kingdoms at Westminster. Cromwell's government was a tyranny, it is true, but those five years of the Protectorate are the only five years of good government Ireland ever had until our own day.

Protestant Ascendency.—Charles II. hastened, on his accession, to undo the work of Cromwell in the union of the three kingdoms. He could not, however, undo the Cromwellian settlement. After five years' bitter struggle the Presbyterian soldiers were left in possession on surrender of a third of their claims, a surrender which in many cases was only nominal. At this time only about a fifth of the island remained in Roman Catholic hands. The Earl of Ormond was made a duke, and was viceroy during the whole reign; his rule was moderate and conciliatory. The re-establishment of the Irish Protestant Episcopalian Church was a very unpopular measure, indeed it is rather hard quite to understand Charles's motive in it. Ireland was Roman Catholic or Presbyterian, and all parties disliked the Established Church. Many Puritan ministers were dismissed, and a considerable emigration to America took place. Charles died a Catholic; his brother James, who succeeded as James II., was more conscientious, and had long before avowed his religion. The Protestants trembled therefore, dreading a terrible retaliation for their past harshness when James II. began to put into force his schemes for promoting the Catholic religion. But James had to bow before the scorn of England, and his son-in-law, William of Orange, with his wife Mary Stuart, occupied his throne in 1688. James left France, his first place of refuge, for Ireland in 1689, landing at Kinsale with a mixed French and Irish force of about 1500. Londonderry held out for William; James therefore sat down before it. Under the Rev. George Walker a heroic defence was made during 105 days. The besieged were reduced to eating rats and gnawing leather till three English ships broke the boom across the river, and reached them with supplies, upon which James withdrew. The Parliament which he summoned was as chiefly Catholic as its predecessors had been Protestant. It repealed the Acts of Settlement passed at the beginning of Charles II.'s reign, the Poynings Acts of 1495, which placed Irish Parliaments under English control, &c., and passed a comprehensive Act of Attainder on 2600 partisans of William III., confiscating their estates. William sent over Schomberg, but James could meet him with double his force, and compel him to retire into Dundalk. William therefore felt that he must himself leave England, although the risk was so great, for while James II. still reigned at Dublin there could be no hope of settlement. Meanwhile James, penniless, coined brass money at Dublin, compelling people to take these tokens as value for £5 and such other values as he chose to put upon them. Much ruin was caused by this. The Duke of Lauzun, however, reinforced James with 7000 picked French soldiers. The two kings met at the river Boyne, near Slane, 1st July, 1690. William crossed the river, though wounded by a cannon ball the day before; James, as soon as he saw the day going against him, fled and did not stop till he again reached France. "Change kings," said the Irish officers, "and we'll fight you again." William entered Dublin on 7th July; but a great part of Ireland still held out against him, the great leader on the Jacobite side being Colonel Patrick Sarsfield, a splendidly heroic, generous, and handsome man. His most daring exploit was the capture of one of William's artillery trains on its way to the siege of Limerick, which Sarsfield held, and his blowing up the guns with their own powder. Indeed William had to raise the siege, being compelled to return to England. Meanwhile Ginkel gained the battle of Athlone over the French commander, St. Ruth, and the Irish Earl of Tirconnaill (June, 1691); and again he beat the same commanders at Aughrim, 12th July; 7000 Irish fell, and the gallant St. Ruth among them. Tirconnaill retired to Limerick to die, and Sarsfield succeeded to the command. But he had to capitulate after a brilliant struggle, while yet powerful enough to claim excellent terms (October, 1691). It was agreed that Catholics should enjoy freedom of religion, and retain their estates upon swearing allegiance to William and Mary. The Parliament of 1695, which met to ratify this, was as usual exclusively Protestant, and quietly omitted the provisions. The military treaty was more faithfully observed. Sarsfield and 20,000 men passed safely into France, where they formed the nucleus of the Irish brigade which won laurels in the long wars from Blenheim to Fontenoy. Altogether it has been reckoned that from 1691 to 1745 not less than 500,000 Irishmen fell in the French service.

This Parliament of 1695 took a fearful revenge for the Jacobite war in its penal laws against the Catholics. The Acts of James II.'s Parliament, the only one which contained Catholics of any Irish Parliament since the Reformation, were all annulled. Roman Catholics were forbidden to employ Roman Catholic teachers for their children under pain of outlawry, nor were they even free to send them abroad to be educated. They were not allowed to keep arms except in a few special instances, nor to learn the trade of gunsmith or cutler. They were bound to sell their horse for £5 to any Protestant who might choose to buy it. These measures not producing the wholesale conversion that was hoped, the same Parliament in 1697 went further. All Roman Catholic priests were ordered to leave Ireland; to stay or to return was high treason. On the other hand, renegade priests received a yearly pension of £20. Mixed marriages were prevented by two simple laws. If the wife were a Protestant all her property on her marriage with a Roman Catholic went at once to her heir-at-law, supposing the heir were a Protestant, just as if she had died intestate. If the husband were a Protestant he became amenable to the whole penal legislation upon his marriage with a Roman Catholic, just as if he had been converted. Competent observers declared that about a seventh of Ireland only was left in the hands of Roman Catholics on the accession of Anne.

So far went the Protestant revenge, but a further evil

was to fall upon Ireland. The woollen manufacture had become flourishing, and bade fair in the new and vigorous state which was the good side of the Protestant ascendency to rival the ancient woollen trade of England. The Irish Parliament had angered its great neighbour, and the complaints of the jealous woollen trades in England were receiving attention. To avert a worse calamity the Irish Parliament offered in 1698 to lay a duty of 4*s*. in the £1 on cloths, and 2*s*. on flannels, exported from Ireland; and further, prohibited even this crippled export except from a few specified ports in Ireland to a few in England. Irish cloth making was ruined at a blow, and the English merchants could buy Irish wool for 1*s*. a pound whose proper value was three or four times as much. Naturally wool-smuggling grew to an enormous extent, especially in favour of France, always ready to welcome an opportunity of lending a hand to Irish disaffection.

In 1704 the climax of the penal laws was reached in that inhuman statute which disgraces the Irish Parliament, whereby if a Roman Catholic held land, he was deprived of all power of selling or holding in any other way than as a simple annual tenant if his eldest son became Protestant. The old Irish custom, as we have seen, was to divide estates equally; under this law the eldest son who was a Protestant inherited the whole, to the prejudice of his brethren. But Roman Catholics might acquire estates, and so gain on the one hand what they lost on the other. This was stopped by rendering it penal for a Roman Catholic either to buy land or to receive it by inheritance. The Protestant dissenters also were aimed at by the Schism Act, which made it criminal to teach in school without a license, the license being obtainable only through a bishop, and after taking the Lord's Supper in the English Church. The nonconformists were expelled from the magistracy, and their marriages proclaimed void. The *Regium Donum*, which William III. had granted the Presbyterian ministers, £1200 a year out of the Belfast Customs, was withdrawn. All this was in 1713, the year before Anne died, and the year in which Swift was made Dean of St. Patrick's.

Irish Independence.—The enormous efforts for Ireland which Swift made were nominally upon trumpery questions, like "Wood's halfpence." This was a coinage which a certain William Wood of Wolverhampton was authorized by patent to supply to Ireland up to £90,000. Swift caused it, by his own unrivalled power, to be rejected; the patent was withdrawn and Wood compensated. These were the times of the celebrated letters of M. B., a draper of Dublin, due of course to Swift, though no one claimed the government reward of £300 offered to whoever would betray the author's name. But the dean's real aim was the unification of Ireland on any subject whatever. The curse of absenteeism drained the country, agriculture was neglected except as to mere pasturage, because pasture land was free of the hated tithe of the Established Church. Swift said that the Irish were "mere hewers of wood and drawers of water;" Chesterfield, who came a little later, and who certainly cannot be credited with sentimentality, said "The poor of Ireland are worse used than negroes by their masters." So passed the reigns of George I. and George II. Numbers of Irish continued to escape and join the armies of France, though when they were caught they were hanged. In the year of George II.'s death (1760) a French expedition of three ships, under Thurot, landed in Ireland, after severe mishaps on the way. Five ships had started from Dunkirk with 700 sailors and 1400 soldiers; two ships were lost in flying from the English cruisers, and the rest arrived almost starving. They succeeded in taking Carrickfergus Castle, and joyfully sacked the town. But on the Belfast garrison making ready, Thurot re-embarked. Captain Elliot sailed after him from Kinsale with three ships, and captured the whole expedition after a sharp action, in which Thurot was shot.

The legislative independence of Ireland was limited by Poynings' Act of 1495, as has been shown; but its judicial independence had not been questioned until the Annesly case in 1719. The matter was a mere dispute of title to land, referred higher and higher on appeal, till it was settled in favour of Annesly's opponent by the Irish House of Lords. On this Annesly appealed to the English House of Lords, which reversed the decision. The Irish peers, enraged at this, took the decided step of imprisoning the Irish judges who had issued orders in obedience to the English House of Lords. Instantly England fired up; an Act was passed at Westminster declaring Ireland subordinate to the crown of Great Britain, and denying any separate jurisdiction to the Irish House of Lords (6 Geo. I.) This blow fell on the Protestants alone, and although they made no alteration in the Protestant tyranny, yet they began to draw nearer the Roman Catholics as opponents of England. A famine, in which a fifth of the people perished, occurred in 1739, resulting from a bad potato crop, and called forth some further disposition to work together. When, therefore, England began to make proposals for renewing the Union as under Cromwell the whole country protested, and an armed mob of many thousands broke into the Houses of Parliament on College Green, and were not dispersed without military force and much bloodshed. This started a parliamentary agitation against Poynings' law, which grew rapidly in strength; the Roman Catholics, denied the legitimate way of expressing their feelings, resorted to secret conspiracies. But conspiracy once begun cannot be easily checked, and many of the Roman Catholic societies degenerated into mere bands of marauders, who, being disguised by shirts worn over their clothes, became known as Whiteboys. The Whiteboys plundered the Protestants of the south, making their national wrongs an excuse for robbery; often a rude military drill was enforced among the larger bands of them. In the north similar bands of Oakboys and Steelboys, or Hearts of Steel, arose among the Protestants, their wrongs complained of being the continued absenteeism, the legal requirement of six days' labour on the roads and six days' use of a horse every year without charge, the enormous fines on re-leases, and so on. The disorder was of course necessary to be repressed, but the grievances should have disappeared at the same time. Men of sterner metal than the Whiteboys, these Ulster insurgents, getting no relief, emigrated in large numbers, and in America found a new home—in time, too, to join the uprising against the English, and help to start the young republic of the west. Since that time America has grown to be the second home of Irishmen, occupying in our day the place which at the time we are writing of was held by France.

The Irish Parliament having come to be almost perpetual (one lasted for thirty-three years), Lord Townshend, when lord lieutenant, got an Octennial Bill passed; but this did not much mend matters. The Parliament was, in fact, hopelessly corrupt; anything could be done by sinecures and pensions. With the advent of Burke into the English Parliament and Grattan into the Irish the tone of Irish political life altered wonderfully for the better. As with Swift so with Grattan, the people came to his standard, supported him loyally, and wept at his death as for a father. In 1778 the first stroke was struck. The abominable Act of 1704 as to the property of Roman Catholics, described above, was annulled, and though they were not yet allowed to purchase land, they received permission to lease it for 999 years. In 1779 the test was abrogated, and a Roman Catholic official became here and there possible. There is no doubt that the weakness of England, engaged at this time in a death-struggle with her American colonies, helped to win these victories. England was afraid

of a rising in Ireland, and in Ireland the Protestants were afraid of a rising among the Catholics. When 4000 Irish troops were sent to America, Ireland was actually able to refuse to receive 10,000 Hessians whom George III. proposed to introduce to replace them from Hanover. A force of Protestant volunteers was raised for the defence of the island; it grew to 100,000 men. Backed by the irrepressible demonstrations of this force, Grattan extorted concession after concession from England. As one member said, "England has sown her laws as dragon's teeth, and they have sprung up as armed men." Lord North granted free export of timber, wool and woollen stuffs, and of glass, and opened all Irish ports to trade with the colonies. But this was not enough; debate after debate was held on the question of independence, and since it became gradually manifest that England lay for the time helpless before the new-born unity of Ireland, Grattan was able, on 16th April, 1782, to move the famous amendment to the address at the opening of Parliament, which said "that Ireland is a distinct kingdom, and that this Parliament alone has a right to make laws for her." Fox at once proposed the repeal of the 6 Geo. I. in the English House of Commons, and the independence of the Irish kingdom, the repeal of Poynings' Acts, the Irish Mutiny Bill (giving Ireland the control of the army), and the supremacy of the Irish House of Lords on appeal were all granted. The Irish in return voted a subsidy of £100,000 and a levy of 20,000 men to the English war. Grattan was offered an equal sum of money; he refused, and was with difficulty induced to accept £50,000. No one could call Irishmen ungrateful. A burst of good legislation ennobled the newly won independence of the land. Roman Catholics were given the right to teach and learn as they would, to buy freeholds, &c. The nonconformists were conciliated by their marriages being legalized. Reform was felt to be urgently necessary, however; the numbers of small boroughs, eighty of them being in the hands of a very few persons, created on emergencies by the crown in days gone by, were now a standing grievance and obstruction. A hundred and sixteen seats were controlled by twenty-five large landed proprietors. The volunteers put heavy pressure on the Parliament; they assembled by delegates in a convention in Dublin, and promoted a Reform Bill. It was not carried, but the good feeling of the volunteers prevailed, and they separated peacefully. William Pitt in 1785 endeavoured to remodel Irish government in a thorough and statesmanlike bill, doing away, for one thing, with every restriction on trade, to "draw what remained of the shattered empire together," and by a prosperous Ireland to make good the loss of America. Unhappily he could carry neither country with him. His bill had to be remodelled to get through the English Houses, and it was only offered to Ireland to be at once rejected. It was a bad day for Ireland when that piece of folly was perpetrated. Perhaps some explanation lies in the fact that the pension list of Ireland was now £1,020,000 a year. Outrages began again worse than ever. Peep-o'-Day Boys in the north, who plundered the Roman Catholics, rivalled the Whiteboys of the south, who robbed the Protestants. Roman Catholic Defenders were almost as bad as the Peep o'-Day Boys whom they resisted. Eventually, on the outbreak of the French Revolution, all this discord found a vent. The great body of the United Irishmen was founded at Belfast in 1791, with the support of all creeds, by Theodore Wolfe Tone, a young barrister of twenty-eight, with the view of shaking off what was left of English control, reforming Parliament, and uniting Ireland. Communication was opened with France, but the society was suppressed. It continued to exist in secret, and was speedily converted into a French plot. To conciliate the Roman Catholics the government founded the Roman Catholic College of Maynooth in 1795; the hollowness of Tone's Union was shown by the instant formation of bands of Orangemen, whose object was to expel Roman Catholics from Ulster. Even a battle was fought in Armagh on 21st September, 1795. The wildest anarchy prevailed, even after the military was called out, and transportations were frequent. Except in Ulster, Wolfe Tone succeeded in reuniting his patriots, and leaving behind him Lord Edward Fitzgerald as their leader, he reached France on 18th January, 1796, to solicit aid from the Directory. On 15th December in that year General Hoche and he sailed from Brest with forty-three vessels and 15,000 men, besides artillery and a large quantity of spare arms for the Irish. This fleet met with such bad weather that only sixteen vessels could anchor in Bantry Bay, four were altogether lost, and the constant storms prevented any landing. The government were active in detecting the conspiracy in Ireland; Grattan wisely sought to take the wind out of its sails by proposing to admit all Irishmen to representation irrespective of creed. When he was defeated by 170 to thirty he withdrew from the hopeless attempt to serve his unhappy country. At this time no less than sixty seats were in the hands of the three families of Devonshire, Ponsonby, and Beresford. This Protestant faction would neither let true patriots save Ireland, nor would they do it themselves.

Meanwhile the party of destruction was at work. A great Dutch fleet for Ireland was got together by Tone's influence at the Texel, but Camperdown saw its overthrow by Duncan (1797). Fitzgerald was not idle, and a general rising was planned for 23rd May. On the 19th he was captured, dragged to London, and died of wounds received in the final affray. The rising, bereft of its head, went off in sputters, Wexford alone showing a bold front. Here some 5000 men took Enniscorthy and encamped on Vinegar Hill, 29th May; and a few days later Wexford also fell. Arklow alone now stood between the insurgents and Dublin. They numbered 27,000 by this time. General Needham had to encounter them with only 1600, but he was successful, and their leader, Father Michael Murphy, fell at the moment of defeat. But 14,000 men still remained at Vinegar Hill, and on 21st June, 1798, General Lake succeeded in storming this position and in securing the general of the whole movement, another priest and another Murphy (Father John Murphy, hanged at Tully on 26th June). Other leaders, Thomas Emmet, Arthur O'Connor, &c., made full confession on promise of their lives as exiles. They were sent to Fort George in Scotland till 1802. The danger was not yet over. In August the French under General Humbert landed 1000 men at Killala in Mayo, and Wolfe Tone followed with 3000 more. Humbert had to surrender at Ballinamuck, 8th September, 1798, and Tone's ship was encountered off Lough Swilly, 10th October, by heavy odds, and made to strike her flag. The rebel, still only thirty-five after all his adventurous career, was taken to Dublin and sentenced to be hung. In the night he cut his throat with a penknife (19th November, 1798). The revolt was followed by savage atrocities on the part of the government troops and the adherents of the ruling faction at Dublin, in spite of all the efforts of Lord Cornwallis to prevent it.

Union with Great Britain.—Pitt, disgusted at the bloodstained farce of Irish independence, which handed Ireland over to be plundered by the selfishness and tortured through the bigotry of an irresponsible Protestant oligarchy, determined to put an end to it. Cost what it may, Ireland must be brought into order. At least a million in gold was shamelessly received by the "independent" Irish parliamentarians as the price of their vote, and in June, 1800, Ireland became at last an integral part of the United Kingdom, contributing 100 members to the joint House of Commons, and twenty-eight representative peers, chosen

for life by the peerage of Ireland, with four bishops. The formal proclamation of the Union took place 1st January, 1801, and the Union Jack received the saltire cross of St. Patrick blended with the saltire cross of St. Andrew, in addition to the well-known upright cross of St. George. One very unfortunate point was included in the Act of Union, namely, the incorporation of the Irish with the English Established Church, a source of great heartburnings and bitter memories till the Irish Church was suppressed as a state establishment in 1869 by Mr. Gladstone. [See section on *Religion.*] A rising in Dublin under Robert Emmet in July, 1803, failed to accomplish its object—the seizure of the castle. Some bloodshed occurred, but Emmet was not taken till September, when he was executed in Dublin. In more legal ways the great grievance of Roman Catholic disability was kept steadily before Parliament. George III. as steadily refused to consider it. Grattan procured election to Parliament to lead the cause nevertheless, till his death in 1820. Plunkett succeeded him, and Daniel O'Connell's election for Clare and refusal to take the oath of supremacy in 1828 was the last incident in the long struggle. O'Connell had formed an enormous Catholic Association in Ireland, and the Duke of Wellington, at this time prime minister, seeing quite clearly that persistence in refusal would entail a civil war, practically commanded the hesitating Lords to pass the bill which the Commons had already agreed to for Roman Catholic Emancipation (18th April, 1829). The oath was accordingly altered, and Roman Catholics were at once free to hold all offices but those of regent, lord chancellor, and lord lieutenant.

O'Connell, elate at his victory (for it was mainly due to him), began an equally fervid agitation for repeal of the Union. He resorted to secret and illegal societies, and was tried and found guilty of seditious practices. In a short time his following consisted of thirty-four members of Parliament. In 1841 he organized the Repeal Association, with members subscribing £1 a year and associates subscribing 1*s.* a year; and the "repeal rent" rose to £600 or £700 a week. A quarter of a million persons assembled at Tara to hear the liberator address them upon the revival of their ancient glories. A second meeting was arranged for Clontarf, but the government forbade it, and sent a strong force to guard the site. Six days later O'Connell and the other leaders were arrested for conspiracy (14th October, 1843). The trial lasted twenty-four days. All were found guilty. O'Connell was condemned to imprisonment for a year, and to a heavy fine, but he was released in September, 1844, on appeal to the House of Lords on a writ of error from the court below. His health giving way and his popularity in Ireland declining, in consequence of his steady refusal to use physical force, he went abroad, and died at Genoa in May, 1847, aged seventy-one. The year after O'Connell's trial a terrible famine fell on Ireland (1845), through failure of the potato crop—fatal gift of Raleigh!—and between starvation and the large emigration that was hurriedly resorted to Ireland lost not less than 2,000,000 inhabitants. In this distress a revival of the agitation of O'Connell was attempted by William Smith O'Brien, son of Sir Edward O'Brien, with Meagher and Mitchel, editor of the *United Irishman* newspaper. This was the final outcome of what was called in general the *Young Ireland* movement. Again France, now in the midst of another revolution of its own, assisted Ireland's disaffection. It ended in nothing, however. Mitchel was apprehended and transported. O'Brien was driven about from pillar to post, and eventually found acting a ludicrous parody of war at the head of a few peasants in Ballingarry. He escaped, but was soon taken, tried, and sentenced to death, but so ridiculous was his performance considered that he was pardoned, and died in South Wales in 1864.

One of O'Brien's confederates, John O'Mahony, fled to America, and about 1850 started there the Fenian Brotherhood, which was organized and brought to perfection by James Stephens. The outcome of this dangerous association is given in the article FENIAN. A parliamentary party was formed about 1873 by Mr. Isaac Butt, called the Home Rule party, aiming at the Repeal of the Union; and a national association for the reduction of rents (Land League), which proved not over-scrupulous in the means it used in endeavouring to attain its objects, was formed in 1879 by Messrs. Parnell, Davitt (a Fenian convicted in 1870 and released in 1877 after the expiration of half his sentence), Egan, and Brennan. In consequence of the prevalence of outrages and disturbances said to be instigated by this association it was suppressed by law in 1881. On 6th May, 1882, Lord Frederick Cavendish, who had just arrived in Dublin as chief-secretary to the lord lieutenant in succession to Mr. Forster, was murdered in the Phœnix Park along with the permanent under-secretary, Mr. Burke. On account of this crime, and of the public feeling excited by it, an Act was passed giving the executive greatly increased powers for the detection and suppression of crime, while a large number of persons, including Mr. Parnell, who had been imprisoned on suspicion without trial, were liberated. Meanwhile the grievances which underlay these indications of discontent had also been investigated, and numerous reforms effected. The Irish Church was disestablished and disendowed in 1869, under the circumstances described in the section on *Religion.* The land laws were remodelled first in 1870, and then, more thoroughly and completely, in 1881, and the Reform and Redistribution Acts of 1884 and 1885 enabled the poorest Irishman to make known his feelings in Parliament through a lawful channel.

END OF VOL. VII.

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